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Forest Service

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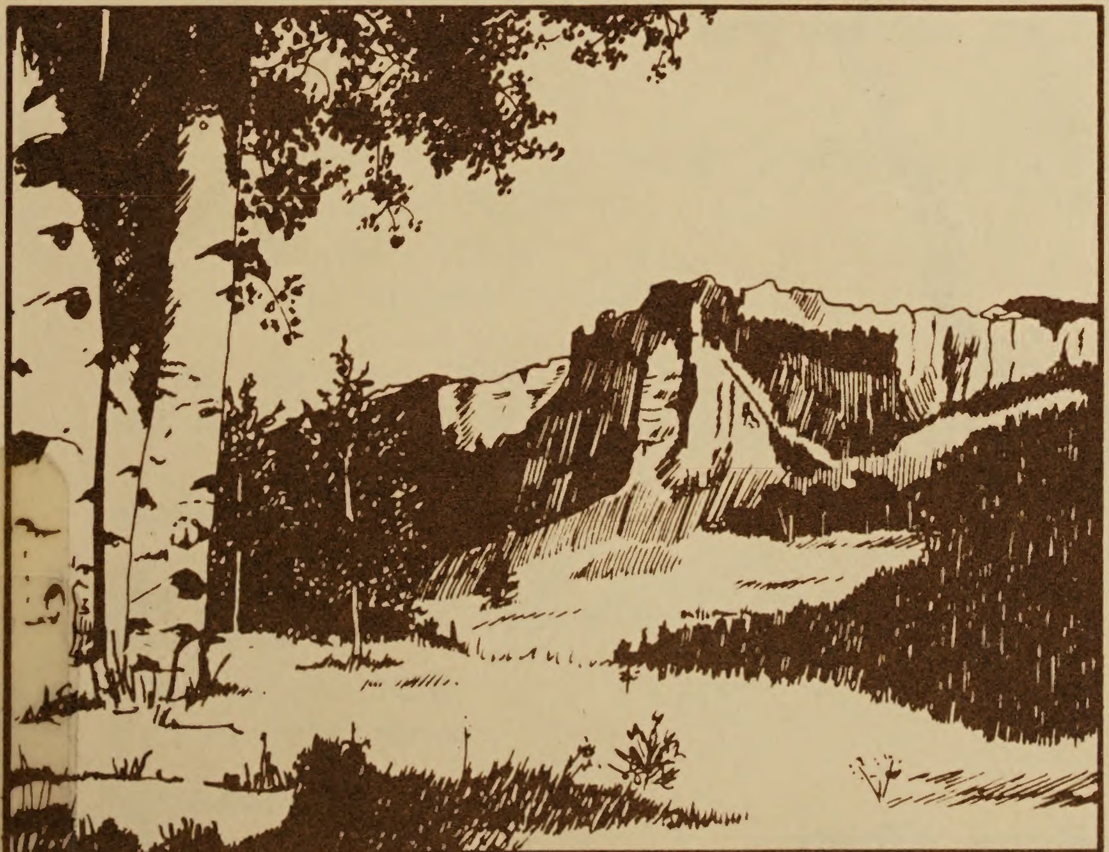
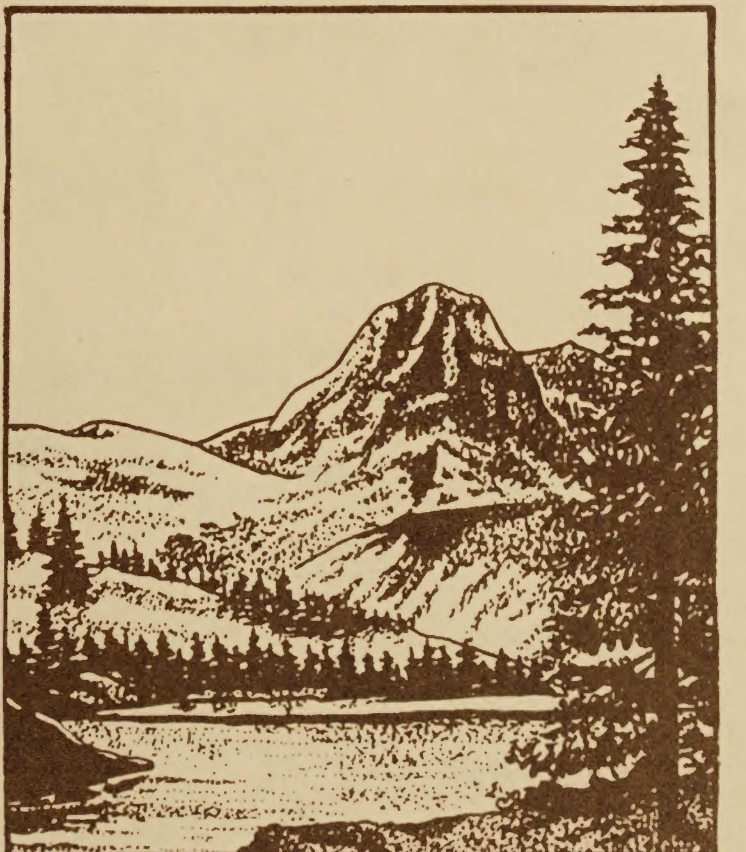
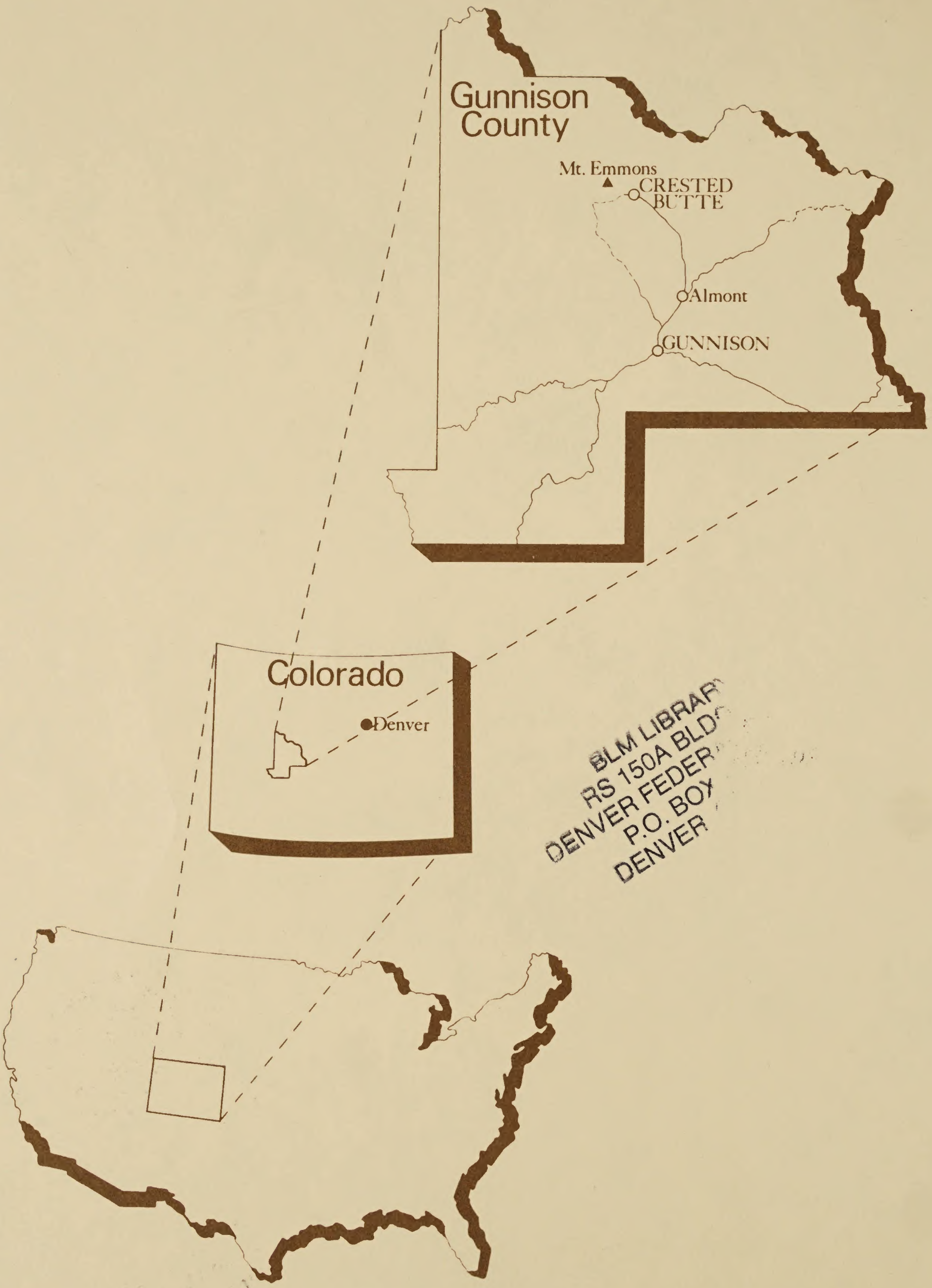
Uncompahgre
and Gunnison
National Forests

MOUNT EMMONS
Mining Project
ENVIRONMENTAL IMPACT STATEMENT

DRAFT






Gunnison County
Mt. Emmons
CRESTED BUTTE
Almont
GUNNISON
Colorado
Denver

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Location Map

United States
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Forest
Service

Grand Mesa, Uncompahgre and
Gunnison National Forests

1063 Main Street
Delta, CO 81416

Reply to: 1950

Date: January 6, 1982

Dear Reviewer:

A copy of the Draft Environmental Impact Statement (DEIS) for the proposed Mount Emmons Mining Project involving lands on the Gunnison National Forest is enclosed. It was prepared under the provisions of Section 102(2)(c) of the National Environmental Policy Act and is now ready for review.

Two public meetings have been scheduled to discuss this DEIS. These public meetings will provide a forum to exchange information and to receive input related to the Mount Emmons DEIS. A time limit may have to be established for oral comments. This will depend on the number of people who wish to comment.

The meetings will be held as follows:

Tuesday, March 2, 1982 - 7:30 p.m. to 10:30 p.m.
Gunnison High School Auditorium; 800 West Ohio Avenue; Gunnison, Colorado

Wednesday, March 3, 1982 - 7:30 p.m. to 10:30 p.m.
Denver Botanical Gardens; John C. Mitchell Hall;
1005 York Street; Denver, Colorado

Because of the high costs of printing and distribution, relatively few copies of the DEIS were printed. Please share this copy with others who may be interested in the proposed Mount Emmons Project. A summary of the alternatives discussed in the DEIS is also available on request and is recommended for those interested in less specific information regarding the proposal.

Written comments are encouraged and will be particularly useful in completing the Final Environmental Impact Statement (FEIS). All comments must be received by March 20, 1982. Please send them to the Forest Supervisor at the following address:

Jimmy R. Wilkins, Forest Supervisor
U.S. Forest Service
1063 Main Street
Delta, Colorado 81416

Thank you for taking time to help us. If you have any questions, please contact the Mount Emmons Project Leader at (303) 641-0471.

Sincerely,

William R Hart Jr
for JIMMY R. WILKINS
Forest Supervisor

Enclosure

FS-6200-11(8-80)

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DRAFT ENVIRONMENTAL IMPACT STATEMENT
MT. EMMONS PROJECT
GUNNISON COUNTY, COLORADO
02-04-81-03

Lead Agency
USDA - Forest Service

Cooperating Agencies
- Bureau of Land Management
- Bureau of Reclamation
- Army Corps of Engineers
- Environmental Protection Agency
- Rural Electrification Administration
- Bureau of Mines
- Department of Energy
- Federal Highway Administration
- Fish and Wildlife Service
- Department of Housing and Urban Development
- Geological Survey
- National Park Service
- Soil Conservation Service

Responsible Officials

Jimmy R. Wilkins
Forest Supervisor
Grand Mesa, Uncompahgre and Gunnison National Forests

Craig W. Rupp
Regional Forester
Rocky Mountain Region

For Further Information Contact

Mt. Emmons Project Leader
216 N. Colorado
Gunnison, Colorado 81230
(303) 641-0471

Abstract: This Draft Environmental Impact Statement is in response to a proposed Plan of Operations submitted by AMAX, Inc. to the Gunnison National Forest for a molybdenum mining and milling project located in Gunnison County, Colorado. The alternatives are:

PRINTING ERROR
TABLE ON P. iii

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Send comments to:
Jimmy R. Wilkins
U. S. Forest Service
1063 Main Street
Delta, CO 81416

BLM Library
D-553A, Building 50
Denver Federal Center
P. O. Box 25047
Denver, CO 80225-0047

Comments must be received by: MAR 20 1982

SUMMARY

DESCRIPTION

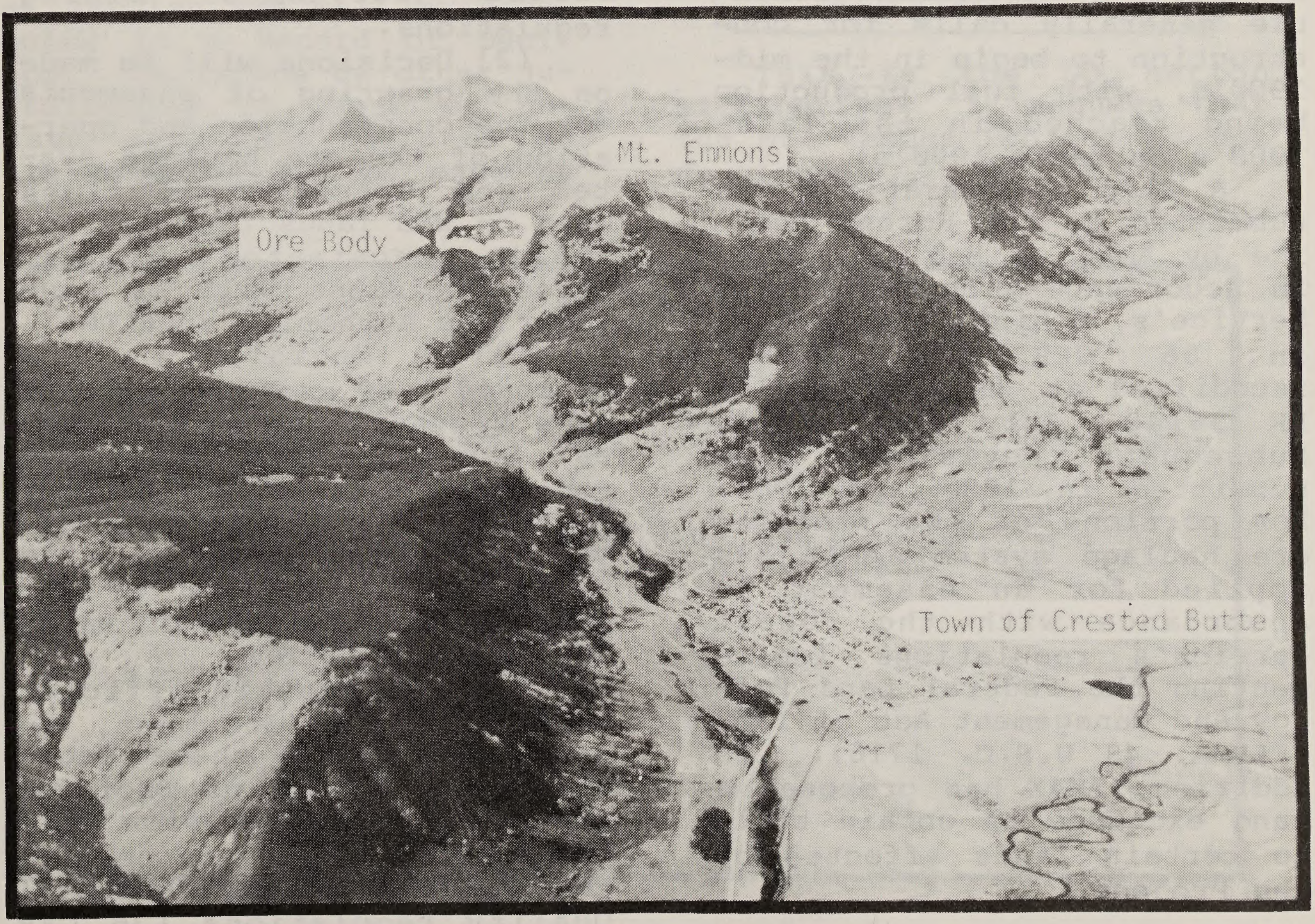
This draft Environmental Impact Statement (EIS) has been prepared by the Forest Service in response to the application by AMAX Inc. to construct and operate a molybdenum mining and milling complex, called the Mt. Emmons Project, partly on National Forest System (NFS) land within Gunnison National Forest in Gunnison County, Colorado. Various federal officials will make decisions regarding the project.

This draft EIS documents an environmental analysis of AMAX's proposal and of reasonable alternatives to it. It was prepared in accordance with Section 102(2)(C) of the National Environmental Policy Act of 1969 (NEPA) and subsequent regulations promulgated by the Council on Environmental Quality (40 CFR Parts 1500-1508).

An EIS is not a decision document. It is a document disclosing the environmental consequences of implementation of the proposed action and alternatives to the proposed action. It is an important document for Federal, State, and local governments to use in arriving at their individual decisions regarding the proposed action and alternatives to it.

PROJECT SUMMARY

The ore body lies under Mt. Emmons, which rises immediately west of the Town of Crested Butte. Portions of the ore body underlie patented



mining claims, while the remainder underlie NFS lands.

AMAX's proposal involves the following facilities: (a) a mine site on Mt. Emmons in the Coal Creek drainage; (b) a mill site and tailing disposal area in the Alkali Creek area twelve miles southeast of the ore body; (c) a rail ore haulage system; (d) major access roads; and (e) overhead transmission lines connecting the project with two independent sources (one located near Gunnison and one near Paonia). Federal, State and private lands are involved.

As proposed, the project will produce approximately 20,000 tons of ore per day and about 63 million pounds of molybdenum disulfide concentrate per year. The life of the mine will be approximately 30 years. The current schedule generally calls for construction to begin in the mid-1980's, with full production being reached in the late-1980's or early-1990's.

A Plan of Operations was submitted to the Forest Service by AMAX on May 18, 1979, in accordance with the Forest Service's mining regulations in 36 CFR 252 (1980) recodified at 36 CFR 228 (46 FR 36142, July 14, 1981). Subsequent revisions were submitted in 1980 and 1981. For portions of the proposed ore haulage system, AMAX has applied for an easement in accordance with the Forest Service's regulations implementing the Federal Land Policy and Management Act of 1976 (FLPMA, 43 U.S.C. 1716). In addition, AMAX has proposed a land exchange to obtain title to certain lands affected by the Project.

Gunnison County Electric Association (GCEA) has applied for easements for overhead transmission lines to serve the Project. This application was submitted under the Forest Service's regulations implementing FLPMA.

PROJECT DECISIONS

The Forest Service must make several decisions regarding the Project, as described below:

(1) A decision will be made identifying the Plan of Operations that is approved. This will detail the manner in which AMAX is authorized to operate on its unpatented mining and milling claims on NFS lands. The decision on this approval will be made under the authority of the Forest Service's mining regulations.

(2) Decisions will be made on the granting of easements for the construction and operation of the ore haulage system and transmission lines when on NFS lands that are not AMAX's unpatented claims. These decisions will be made under the authority of FLPMA.

(3) A decision on the proposed land exchange will be made by the Chief of the Forest Service, with oversight review by the House Interior Subcommittee on Public Lands. This decision will be made under the authorities of the General Exchange Act of March 20, 1922, and FLPMA.

The responsible official will use this document, in part, in making these decisions. A Record of Decision documenting the decision will be prepared in accordance with the Council on Environmental Quality regulations (36 CFR

1505.2). The Record of Decision will include a discussion of the relevant factors and essential considerations which were balanced in making the decision and state how those considerations entered into the decision.

The environmental consequences on lands and activities administered by other Federal, State, and local jurisdictions resulting from the proposed action are disclosed in this draft EIS. Through cooperation, other Federal, State, and local jurisdictions have assisted in the disclosure of environmental consequences and the development of alternatives to the proposed action.

The Forest Service decisions will relate only to lands administered by the Forest Service and will be documented in a Record of Decision. Decisions by other jurisdictions to issue or not issue approvals related to this proposal can be made by them based on the disclosure of impacts available in this document.

ALTERNATIVES CONSIDERED

The Forest Service analyzed seven major alternatives. These are summarized in the table below and described in detail in the following pages.

Two sets of mitigation measures were developed. One was put together by AMAX; the other is based on mitigation measures compiled by the Forest Service. One of these sets is applied to each of the seven alternatives described in the following pages, as specified in the description of each alternative.

ALTERNATIVE 1

This is the No Action alternative. It assumes that the Mt. Emmons Project is not developed.

PROJECT ALTERNATIVES

						POWER TRANSMISSION: VOLTAGE & CONSTRUCTION METHOD				
ALTERNATIVE	MINE LOCATION	MILL LOCATION	ORE HAULAGE ROUTE	WORKER ACCESS ROUTE	TONS OF ORE PER DAY	PAONIA TAP TO MINE	MINE TO GUNNISON	GUNNISON TO SOUTH TAP	LAND EXCHANGE	MITIGATION MEASURE(3)
1 No Mine	---	--	---	---	0	---	--	--	NA	---
2 AMAX(1)	Coal Cr.	Alkali	Carbon	Colo. 135	20,000	115 kV OH	115 kV OH	230 kV OH	Proceed(4)	A
3 FS(2)	Coal Cr.	Alkali	Carbon	Colo. 135	20,000	115 kV OH	115 kV OH	230 kV OH	Proceed(5)	B
4	Slate R.	Alkali	East R.	Colo. 135	20,000	115 kV OH	115 kV OH	230 kV OH	NA	B
5	Coal Cr.	Carbon	Splains	Colo. 135	20,000	230 kV OH	115 kV OH	230 kV OH	NA	B
6	Coal Cr.	Carbon	Splains	Colo. 135	10,000	230 kV C	115 kV OH	230 kV OH	NA	B
7	Coal Cr.	Chance Gulch	Ohio Cr.	Colo. 135 & US 50	30,000	115 kV OH	115 kV OH	115 kV OH	NA	B

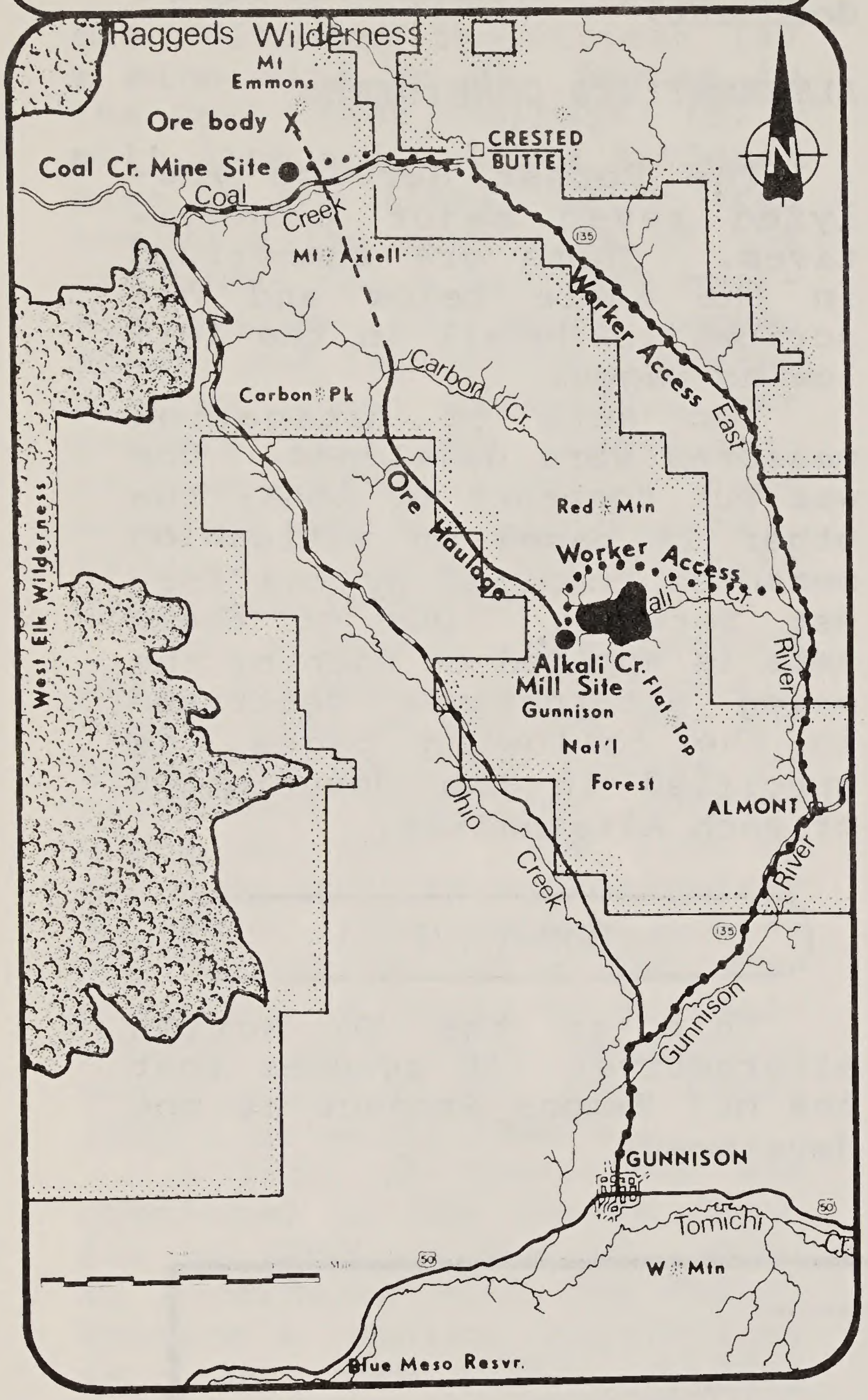
---

(1) This is AMAX's proposal.
(2) This is the Forest Service Preferred Alternative.
(3) Column entries refer to mitigation source:
A = measures proposed by AMAX
B = measures identified by the Forest Service, BMML, and AMAX
(4) AMAX's proposal is analyzed without modifications.
(5) AMAX's proposal is analyzed with modifications.

NA = Not Applicable: The land exchange proposal applies only to Alternatives 2 and 3.
OH = Overhead construction
C = Combination overhead and underground construction

163 mmB

ALTERNATIVE 2


Raggeds Wilderness
Mt Emmons
Ore body X
Coal Cr. Mine Site
Coal
Creek
CRESTED BUTTE
Mt Axtell
135
Worker Access East
Carbon Pk
Carbon Cr.
Ore Haulage
Red Mtn
Worker Access
Alkali Cr. Mill Site
Gunnison Nat'l Forest
Flat Top
West Elk Wilderness
East River
ALMONT
Ohio Creek
River
135
Gunnison
GUNNISON
50
Tomichi
W Mtn
50
Blue Mesa Resvr.
N

This Alternative is a combination of AMAX's and GCEA's proposals. As shown above, it involves a Coal Creek mine site and an Alkali Creek mill site. Tailing is impounded behind an impermeable earth-fill dam.

Ore is hauled by a single track electric rail system along the Carbon Creek route. The route exits from Mt. Emmons down-valley from the mine site, crosses Coal Creek, passes through a 4-mile tunnel under Mt. Axtell, and traverses across the west flank of Red Mountain to the mill. A second 0.7-mile tunnel occurs along this route. Waste rock taken out of the ore haulage tunnel in Mt. Emmons is placed as fill along Coal Creek at the crossing.

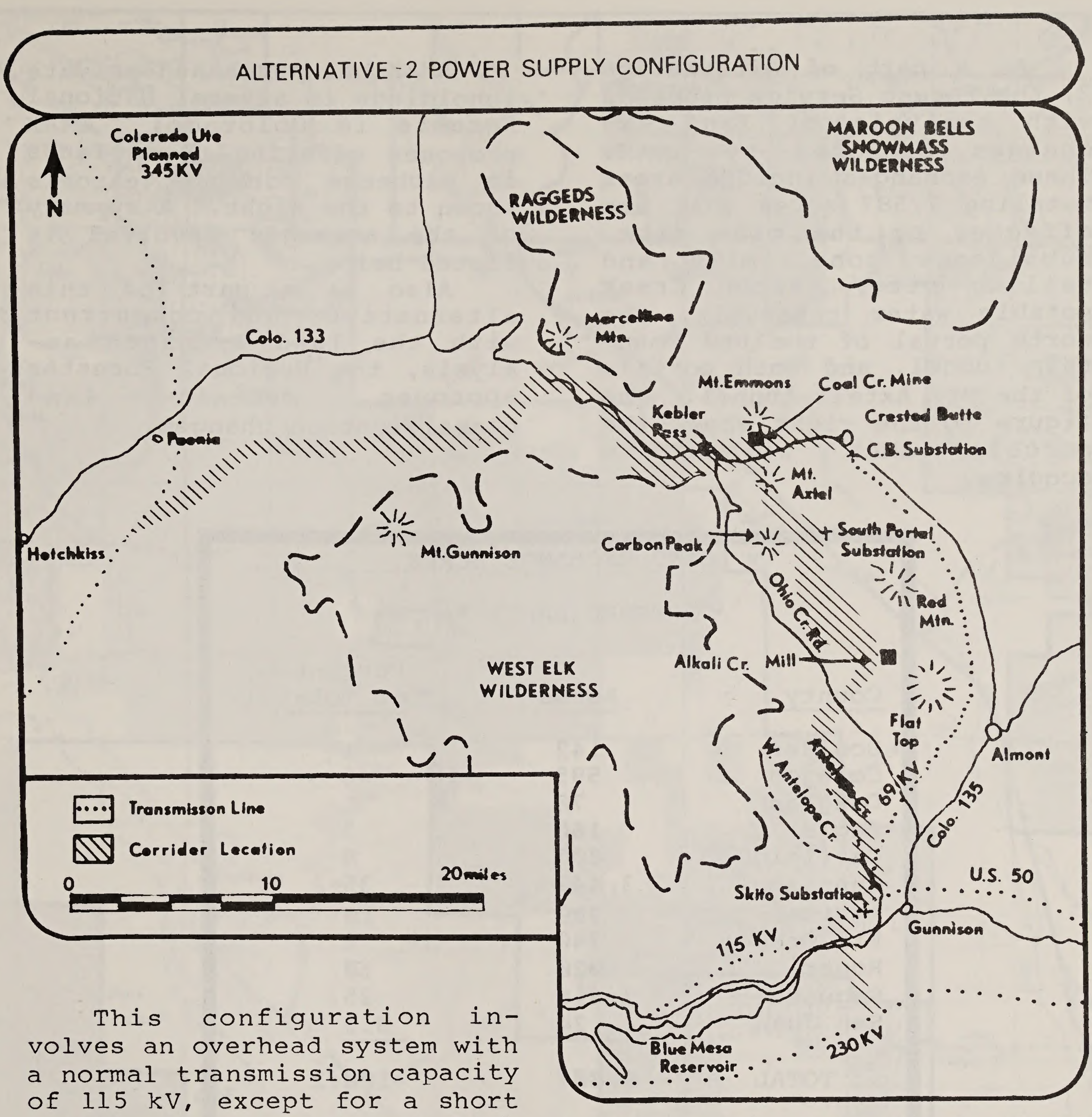
Approximately 155 million tons of ore are mined at a production rate of 20,000 tons per day. A panel caving method is used, and the project life is about 30 years.

Worker access is via Colorado 135 along the East River valley with a bypass around the south side of the Town of Crested Butte for mine access.

Water for the mill is pumped from the East River to a 2,000 acre-foot storage reservoir located below the tailing dam.

Potable water is stored in a 500 acre-foot reservoir located on Carbon Creek one-half mile east of the Mt. Axtell tunnel's south portal. If additional water is needed, a second reservoir will be placed on Elk Creek immediately west of the mine site.

GCEA's proposed power supply configuration is shown on the opposite page. It is designed to serve Alternative 2, but can also serve Alternatives 3-6. AMAX identified a configuration different from the one shown above, but GCEA chose not to adopt it. AMAX's configuration is included in Alternative 7. It is not considered in this alternative because no applications have been submitted for it.


ALTERNATIVE-2 POWER SUPPLY CONFIGURATION

N
Colorado Ute Planned 345KV
RAGGEDS WILDERNESS
MAROON BELLS SNOWMASS WILDERNESS
Colo. 133
Marcellina Mtn.
Mt.Emmons
Coal Cr. Mine
Kebler Pass
Crested Butte
C.B. Substation
Paonia
Mt. Axtel
Hotchkiss
Mt.Gunnison
Carbon Peak
South Portal Substation
Red Mtn.
Ohio Cr. Rd.
WEST ELK WILDERNESS
Alkali Cr. Mill
Flat Top
Almont
Antelope Cr.
W. Antelope Cr.
69 KV
Colo. 135
Transmisson Line
Corridor Location
0
10
20 miles
U.S. 50
Skito Substation
Gunnison
115 KV
Blue Mesa Reservoir
230 KV

This configuration involves an overhead system with a normal transmission capacity of 115 kV, except for a short section at the south end which is a double circuit 230 kV line serving the Skito substation on the west side of Gunnison.

The corridor follows Antelope Creek north from the Skito substation, enters the Ohio Creek valley, and climbs to the Alkali Creek mill site. From there it follows the west slopes of Red Mountain to the east side of Carbon Peak and crosses the west flank of Mt. Axtell to connect with the Coal Creek mine site. A short spur connects the mine site with the Crested Butte substation.

West of the mine site, the corridor crosses through the Kebler Pass area and continues to the vicinity of Paonia.

The mitigation measures proposed by AMAX apply to this Alternative.

As a part of Alternative 2, the Forest Service proceeds with analysis of land exchanges proposed by AMAX. These exchanges include areas totaling 7,587 acres that are affected by the mine site, subsidence zone, mill and tailing site, Carbon Creek potable water reservoir, the north portal of the Red Mountain tunnel, and both portals of the Mt. Axtell tunnel. The figure to the right shows the parcels AMAX wishes to acquire.

AMAX has purchased private inholdings in several National Forests in Colorado. AMAX proposes offering these lands in exchange for the parcels shown to the right. A summary of the acreages involved is listed below.

Also as a part of this alternative, and concurrent with the land exchange analysis, the Regional Forester approves certain land classification changes.

LAND EXCHANGE ACRES

OFFERED LANDS *

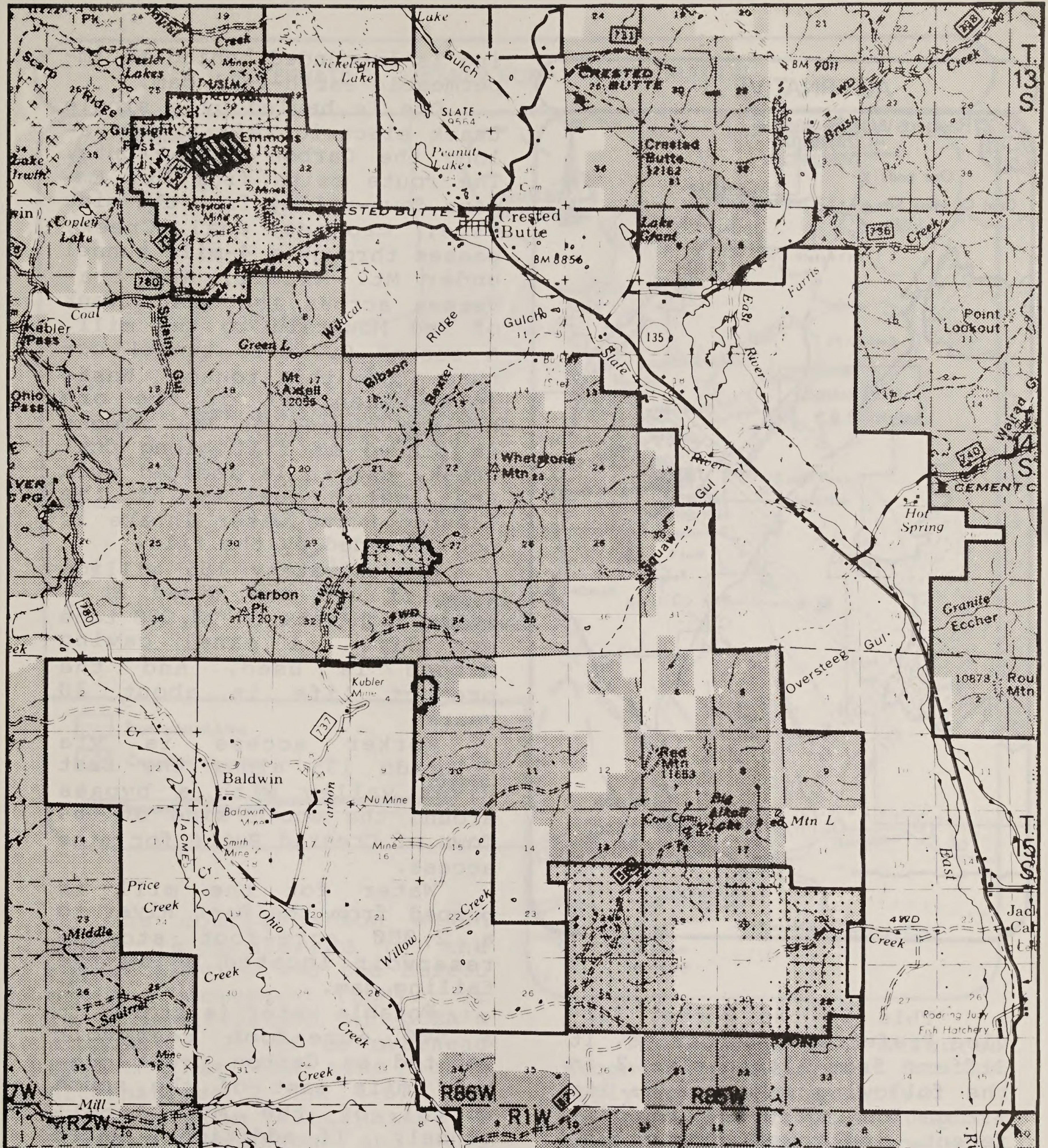
County	Acres	Percent of Total
Boulder	142	1
Conejos	595	6
Douglas	70	1
Eagle	160	2
Garfield	800	8
Gunnison	3,441	35
Larimer	999	10
Rio Grande	240	2
Routt	920	10
Saguache	2,416	25
San Juan	24	0.2
TOTAL	9,807	100.2

SELECTED LANDS **

County	Acres	Percent of Total
Gunnison	7,587	100

* Private lands AMAX has offered to the Forest Service.

** NFS lands AMAX wishes to acquire.


Crested Butte
Mt Emmons 12392
Gunsight Pass
Keystone Mine
Kebler Pass
Ohio Pass
Mt Axtell 12033
Gibson Ridge
Whetstone Mtn
Carbon Pk 12079
Kubler Mine
Baldwin
Baldwin Mine
Smith Mine
Nu Mine
Red Mtn 11653
Mtn L
Crested Butte 12162
Lake Grant
Point Lookout
Hot Spring
Granite Eccher
Roaring Judy Fish Hatchery
Ohio Creek
Slate River
East River
Price Creek
Willow Creek
Carbon Creek
Coal Creek
Oversteeg Gul
T. 13 S.
T. 14 S.
T. 15 S.
R86W
R85W
R1W
0 2 4 miles

LEGEND

▨ LANDS AMAX PROPOSES TO ACQUIRE BY MINERAL PATENT.

⬚ LANDS AMAX PROPOSES TO ACQUIRE BY LAND EXCHANGE.

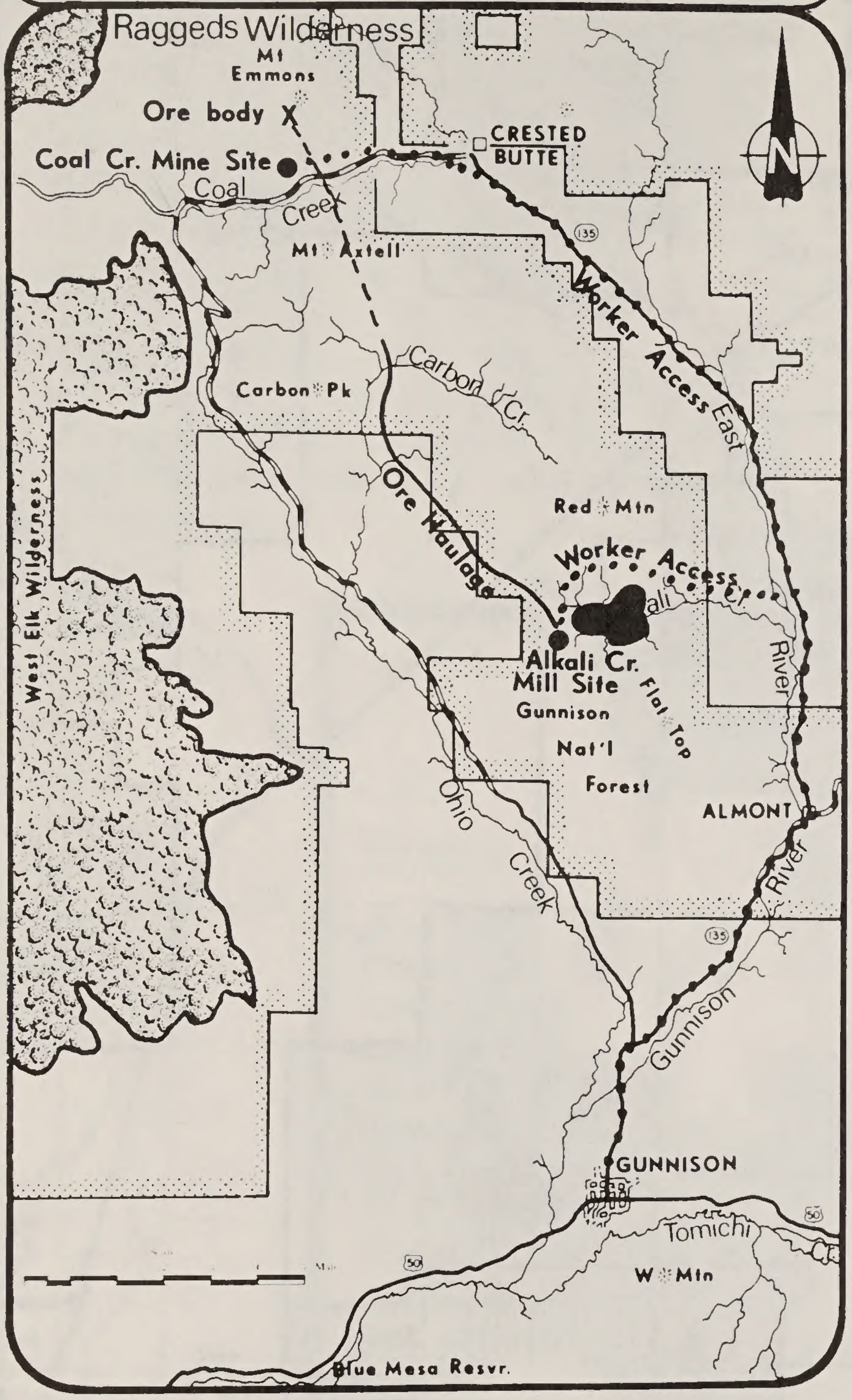
▩ NATIONAL FOREST LAND.

Mt. Emmons Mining Project

LANDS AMAX PROPOSES TO ACQUIRE

July 1981

ALTERNATIVE 3


Raggeds Wilderness
Mt Emmons
Ore body
Coal Cr. Mine Site
Coal Creek
CRESTED BUTTE
Mt Axtell
135
Worker Access East
Carbon Pk
Carbon Cr
Red Mtn
Ore Haulage
Worker Access
Alkali Cr. Mill Site
Flat Top
Gunnison Nat'l Forest
East River
ALMONT
West Elk Wilderness
Ohio Creek
River
Gunnison
135
GUNNISON
Tomichi
50
W Mtn
Blue Mesa Resvr.

This is the Forest Service Preferred Alternative. It differs from Alternative 2 in the following major ways: its mitigation measures are different, its power supply configuration is different between Gunnison and the mill, and it considers a number of variations to the land exchange proposal.

This alternative involves a Coal Creek mine site and an Alkali Creek mill site. Tailing is impounded behind an impermeable earth-fill dam.

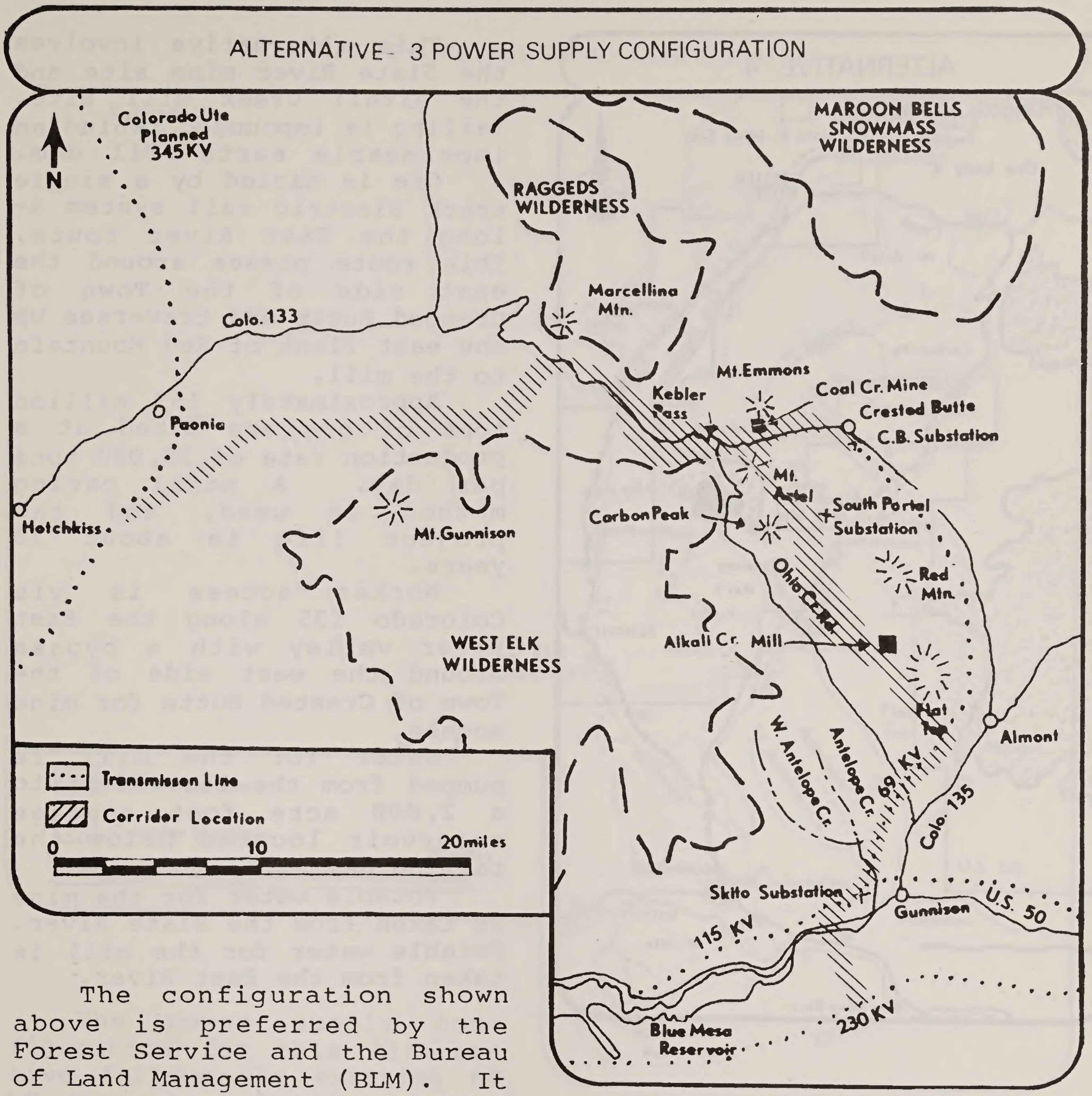
Ore is hauled by a single track electric rail system along the Carbon Creek route. The route exits from Mt. Emmons down-valley from the mine site, crosses Coal Creek, passes through a 4-mile tunnel under Mt. Axtell, and traverses across the west flank of Red Mountain to the mill. A second 0.7-mile tunnel occurs along this route. Waste rock taken out of the ore haulage tunnel in Mt. Emmons is placed as fill along Coal Creek, but it is located such that water quality at the Crested Butte water intake is not degraded by the fill.

Approximately 155 million tons of ore are mined at a production rate of 20,000 tons per day. A panel caving method is used, and the project life is about 30 years.

Worker access is via Colorado 135 along the East River valley with a bypass around the south side of the Town of Crested Butte for mine access.

Water for the mill is pumped from the East River to a 2,000 acre-foot storage reservoir located below the tailing dam.

Potable water is stored in a 500 acre-foot reservoir located on Carbon Creek one-half mile east of the south portal of the Mt. Axtell tunnel. If additional water is needed, a second reservoir will be placed on Elk Creek immediately west of the mine site.


ALTERNATIVE- 3 POWER SUPPLY CONFIGURATION

N
Colorado Ute Planned 345KV
RAGGEDS WILDERNESS
MAROON BELLS SNOWMASS WILDERNESS
Marcellina Mtn.
Colo. 133
Mt.Emmons
Kebler Pass
Coal Cr. Mine
Crested Butte
C.B. Substation
Paonia
Mt. Axtel
South Portal Substation
Carbon Peak
Hotchkiss
Mt.Gunnison
Red Mtn.
Ohio Cr. Rd.
Alkali Cr. Mill
WEST ELK WILDERNESS
Flat Top
Almont
W. Antelope Cr.
Antelope Cr.
69 KV
Colo. 135
Transmisson Line
Corridor Location
0
10
20 miles
Skito Substation
Gunnison
U.S. 50
115 KV
230 KV
Blue Mesa Reservoir

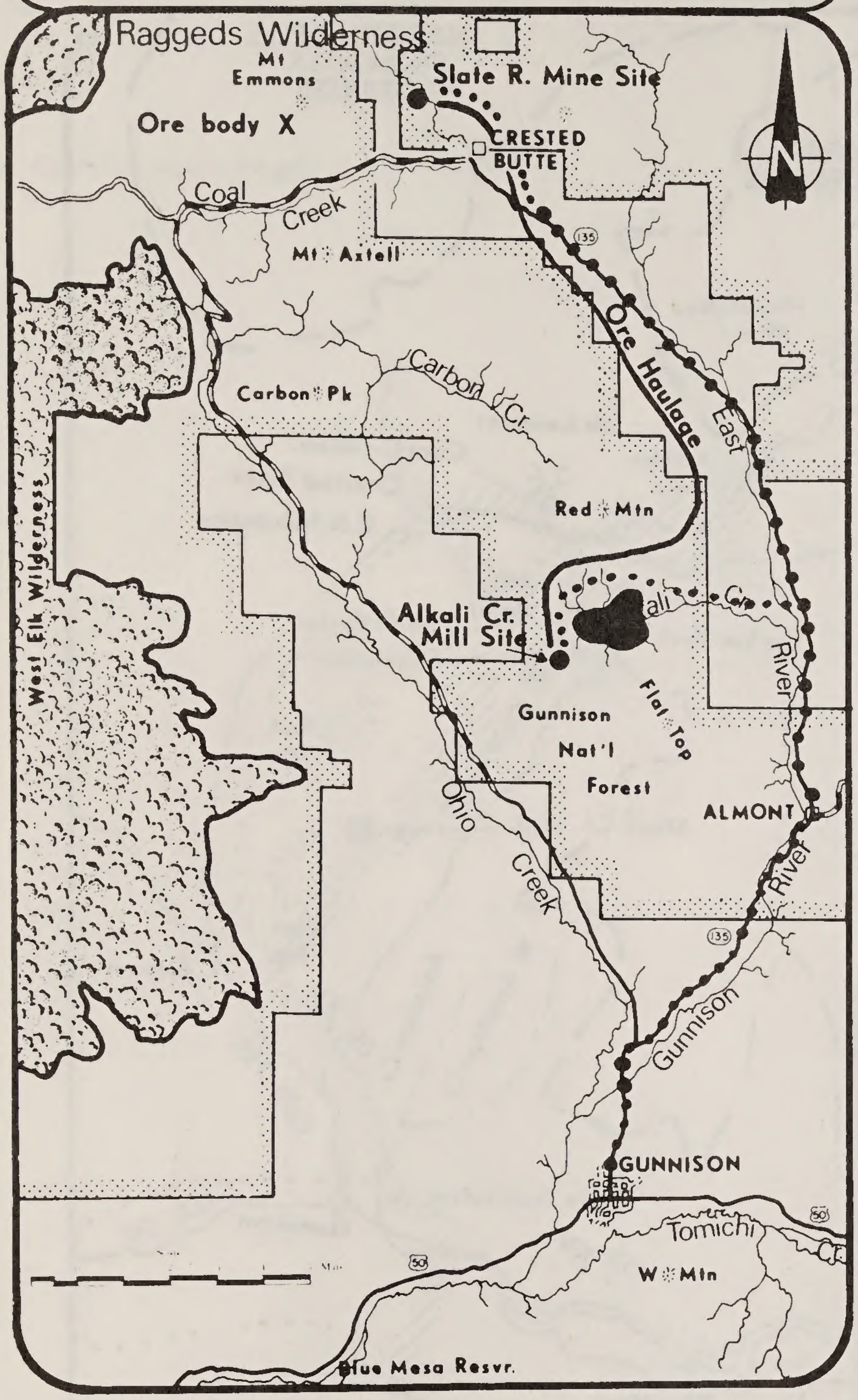
The configuration shown above is preferred by the Forest Service and the Bureau of Land Management (BLM). It is a modification of GCEA's proposal. It is an overhead system that can also serve Alternatives 2 and 4-6. It differs from Alternative 2 between Gunnison and the Alkali Creek mill. The corridor crosses U.S. Highway 50 just west of Gunnison and parallels the existing 69 kV transmission line to the southern slopes of Flat Top. Here it leaves the existing corridor and proceeds along the west slopes of Flat Top to the mill.

The mitigation measures proposed by the Forest Service apply to this alternative.

As part of this alternative, the Forest Service proceeds with analysis of the land exchanges proposed by AMAX (Alternative 2), but it also includes analysis of several variations.

Concurrent with land exchange analysis, the Regional Forester approves appropriate land classification changes.

ALTERNATIVE 4


Raggeds Wilderness
Mt Emmons
Ore body X
Slate R. Mine Site
CRESTED BUTTE
N
Coal Creek
Mt Axtell
135
Ore Haulage
East River
Carbon Pk
Carbon Cr
Red Mtn
West Elk Wilderness
Alkali Cr. Mill Site
Alkali Cr
Flat Top
Gunnison Nat'l Forest
ALMONT
Ohio Creek
River
135
Gunnison
GUNNISON
50
Tomichi Cr
W Mtn
50
Blue Mesa Resvr.

This alternative involves the Slate River mine site and the Alkali Creek mill site. Tailing is impounded behind an impermeable earth-fill dam.

Ore is hauled by a single track electric rail system along the East River route. This route passes around the east side of the Town of Crested Butte and traverses up the east flank of Red Mountain to the mill.

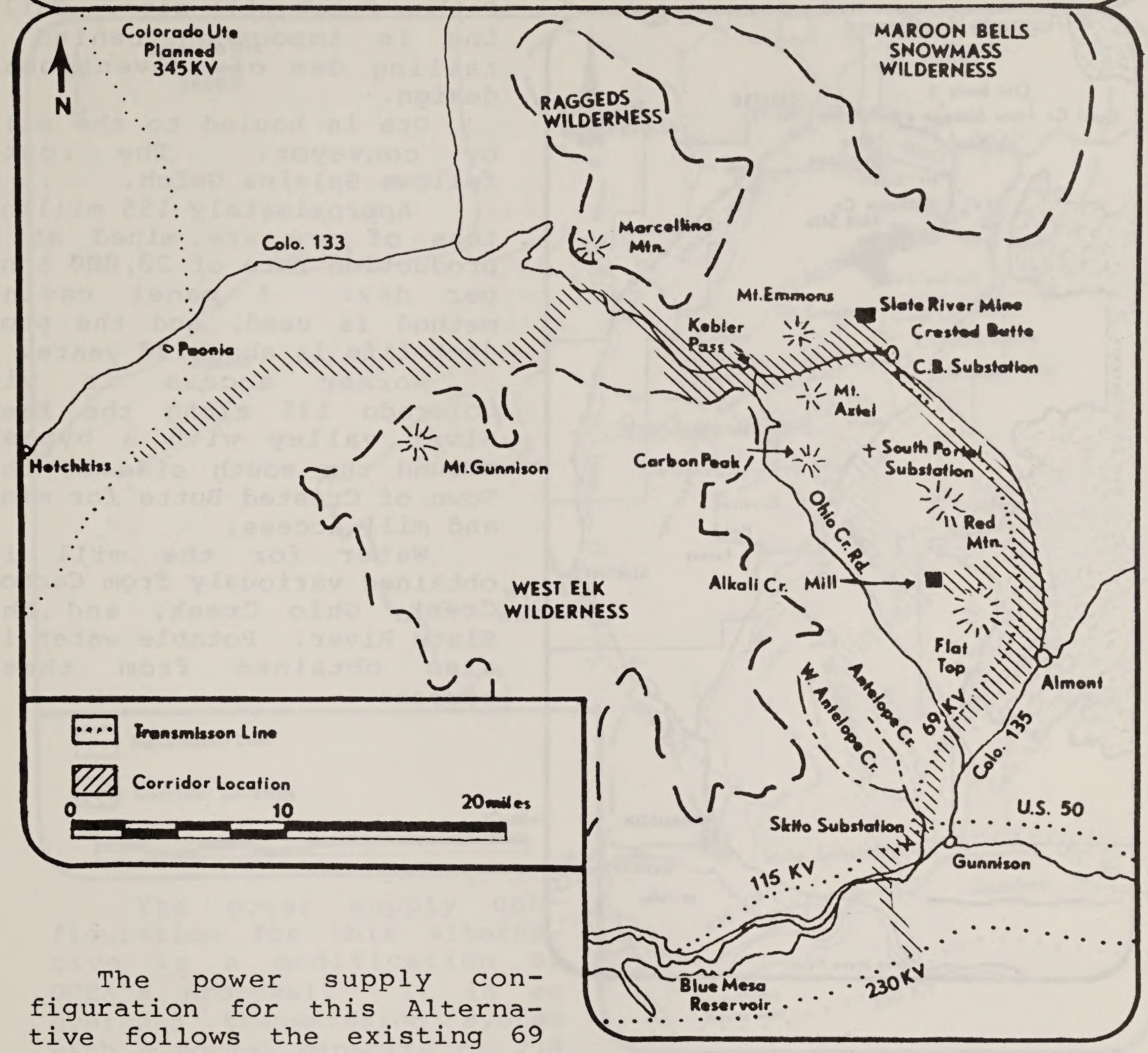
Approximately 155 million tons of ore are mined at a production rate of 20,000 tons per day. A panel caving method is used, and the project life is about 30 years.

Worker access is via Colorado 135 along the East River valley with a bypass around the east side of the Town of Crested Butte for mine access.

Water for the mill is pumped from the East River to a 2,000 acre foot storage reservoir located below the tailing dam.

Potable water for the mine is taken from the Slate River. Potable water for the mill is taken from the East River.

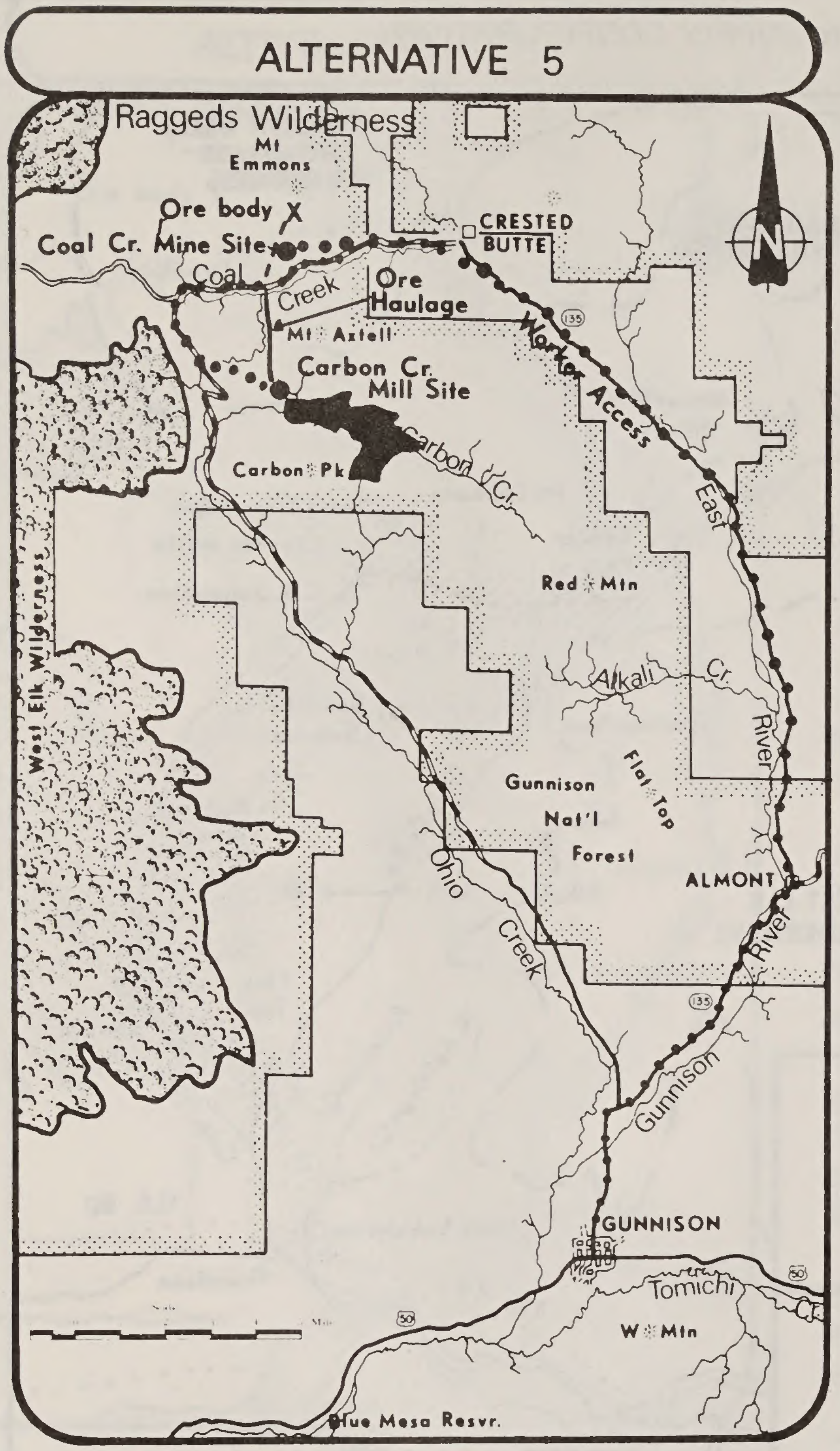
ALTERNATIVE-4 POWER SUPPLY CONFIGURATION


Colorado Ute
Planned
345KV
N
RAGGEDS
WILDERNESS
MAROON BELLS
SNOWMASS
WILDERNESS
Colo. 133
Marcellina
Mtn.
Mt.Emmons
Slate River Mine
Crested Butte
Kebler
Pass
C.B. Substation
Paonia
Mt.
Axtel
Hotchkiss
Mt.Gunnison
Carbon Peak
South Portal
Substation
Ohio Cr. Rd.
Red
Mtn.
WEST ELK
WILDERNESS
Alkali Cr.
Mill
Flat
Top
Almont
W. Antelope Cr.
Antelope Cr.
69 KV
Colo. 135
Transmisson Line
Corridor Location
0
10
20miles
U.S. 50
Skito Substation
Gunnison
115 KV
Blue Mesa
Reservoir
230 KV

The power supply configuration for this Alternative follows the existing 69 kV transmission line between Gunnison and the Crested Butte area. It is an overhead system serving only Alternative 4. The corridor crosses U.S. Highway 50 just west of Gunnison and then follows the existing line into the East River valley and on to the Crested Butte substation. A short double circuit spur connects with the Alkali Creek mill site, and a single circuit goes north to the Slate River mine site. The main corridor goes west of Kebler Pass to the Paonia area.

The mitigation measures proposed by the Forest Service apply to this alternative.

No land exchange proposal specific to this Alternative has been identified, but it is possible that one would be submitted if the Alternative were to be implemented.


ALTERNATIVE 5
Raggeds Wilderness
Mt Emmons
Ore body X
Coal Cr. Mine Site
Coal Creek
Ore Haulage
CRESTED BUTTE
Mt Axtell
Carbon Cr. Mill Site
Carbon Pk
Carbon Cr.
Worker Access
135
East River
Red Mtn
Alkali Cr.
Flat Top
Gunnison Nat'l Forest
West Elk Wilderness
Ohio Creek
ALMONT
Gunnison River
GUNNISON
Tomichi Cr.
50
W Mtn
Blue Mesa Resvr.
N

This alternative involves a Coal Creek mine site and a Carbon Creek mill site. Tailing is impounded behind a tailing dam of conventional design.

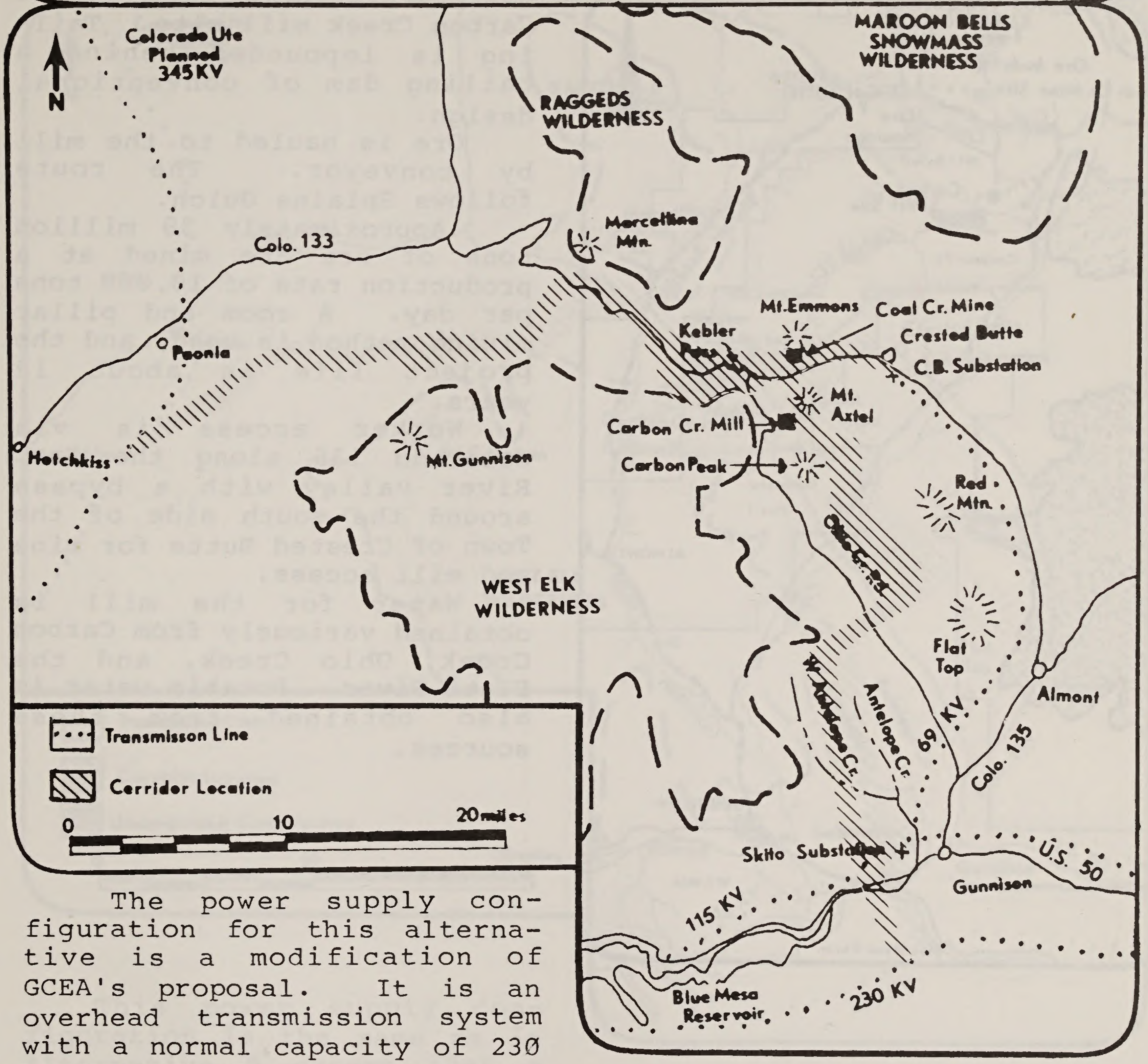
Ore is hauled to the mill by conveyor. The route follows Splains Gulch.

Approximately 155 million tons of ore are mined at a production rate of 20,000 tons per day. A panel caving method is used, and the project life is about 30 years.

Worker access is via Colorado 135 along the East River valley with a bypass around the south side of the Town of Crested Butte for mine and mill access.

Water for the mill is obtained variously from Carbon Creek, Ohio Creek, and the Slate River. Potable water is also obtained from these sources.

ALTERNATIVE-5 POWER SUPPLY CONFIGURATION



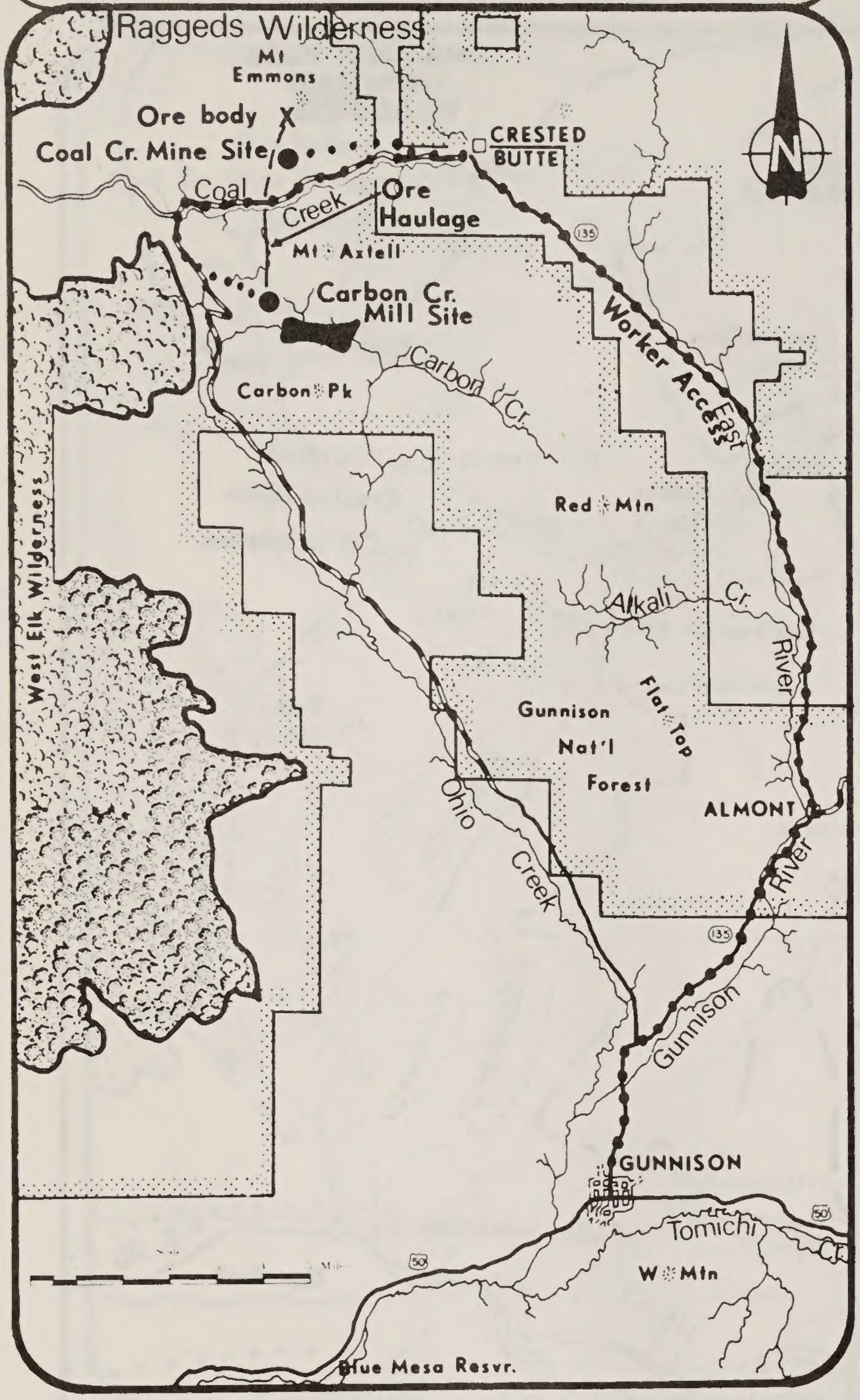
N
Colorado Ute Planned 345KV
MAROON BELLS SNOWMASS WILDERNESS
RAGGEDS WILDERNESS
Marcellina Mtn.
Colo. 133
Paonia
Hotchkiss
Mt. Emmons
Coal Cr. Mine
Crested Butte
C.B. Substation
Kebler Pass
Mt. Axtel
Carbon Cr. Mill
Mt. Gunnison
Carbon Peak
Red Mtn.
Ohio Cr. Rd.
WEST ELK WILDERNESS
Flat Top
Almont
W. Antelope Cr.
Antelope Cr.
69 KV
Colo. 135
Transmisson Line
Corridor Location
0
10
20 miles
Skito Substation
U.S. 50
Gunnison
115 KV
Blue Mesa Reservoir
230 KV

The power supply configuration for this alternative is a modification of GCEA's proposal. It is an overhead transmission system with a normal capacity of 230 kV from the Paonia area to the mine site. The system south to Gunnison has a capacity of 115 kV, with the exception of a short double circuit 230 kV line at the extreme southern end.

The corridor begins southwest of Gunnison and crosses U.S. Highway 50 just west of the city. It turns east a short distance to connect with the Skito substation and then doubles back to turn northward between Antelope Creek and West Antelope Creek. It then proceeds in a northerly direction to the Carbon Creek mill site.

The mitigation measures proposed by the Forest Service apply to this alternative.

No land exchange proposal specific to this Alternative has been identified, but it is possible that one would be submitted if the Alternative were to be implemented.


Raggeds Wilderness
Mt Emmons
Ore body X
Coal Cr. Mine Site
CRESTED BUTTE
Coal
Creek
Ore Haulage
Mt Axtell
Carbon Cr. Mill Site
135
Worker Access
Carbon Pk
Carbon Cr.
East
Red Mtn
Alkali Cr.
River
West Elk Wilderness
Gunnison Nat'l Forest
Flat Top
ALMONT
Ohio Creek
River
135
Gunnison
GUNNISON
50
Tomichi
Cr.
50
W Mtn
Blue Mesa Resvr.
N

ALTERNATIVE 6

This is the "Small Mine" Alternative. It involves a Coal Creek mine site and a Carbon Creek mill site. Tailing is impounded behind a tailing dam of conventional design.

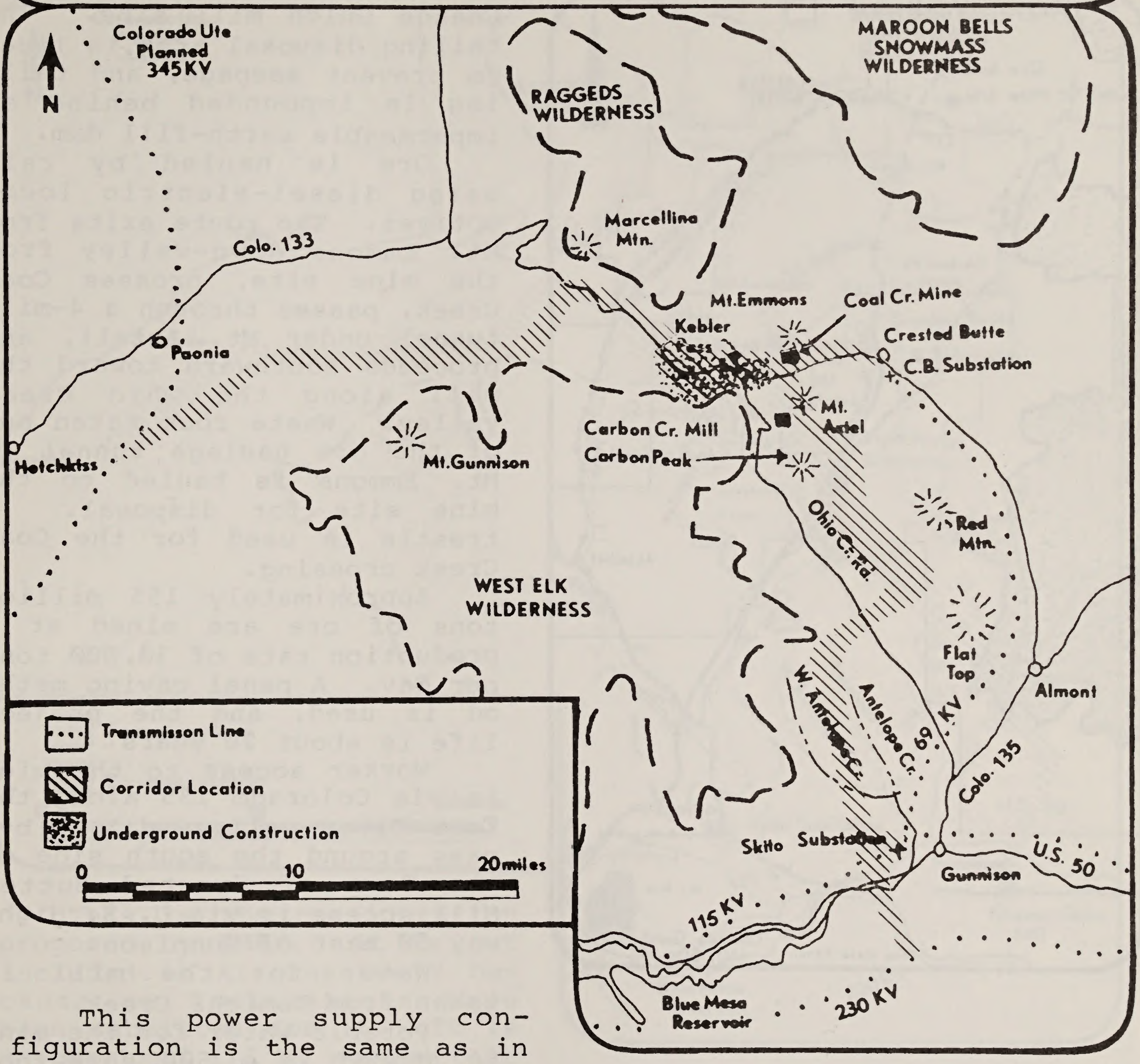
Ore is hauled to the mill by conveyor. The route follows Splains Gulch.

Approximately 38 million tons of ore are mined at a production rate of 10,000 tons per day. A room and pillar mining method is used, and the project life is about 12 years.

Worker access is via Colorado 135 along the East River valley with a bypass around the south side of the Town of Crested Butte for mine and mill access.

Water for the mill is obtained variously from Carbon Creek, Ohio Creek, and the Slate River. Potable water is also obtained from these sources.

ALTERNATIVE 6 POWER SUPPLY CONFIGURATION


Colorado Ute Planned 345KV
N
RAGGEDS WILDERNESS
MAROON BELLS SNOWMASS WILDERNESS
Marcellina Mtn.
Colo. 133
Mt.Emmons
Coal Cr. Mine
Kebler Pass
Crested Butte
C.B. Substation
Paonia
Mt. Axtel
Carbon Cr. Mill
Carbon Peak
Hotchkiss
Mt.Gunnison
Ohio Cr. Rd.
Red Mtn.
WEST ELK WILDERNESS
Flat Top
Almont
W. Antelope Cr.
Antelope Cr.
69 KV
Colo. 135
Transmisson Line
Corridor Location
Underground Construction
0
10
20 miles
Skito Substation
Gunnison
U.S. 50
115 KV
Blue Mesa Reservoir
230 KV

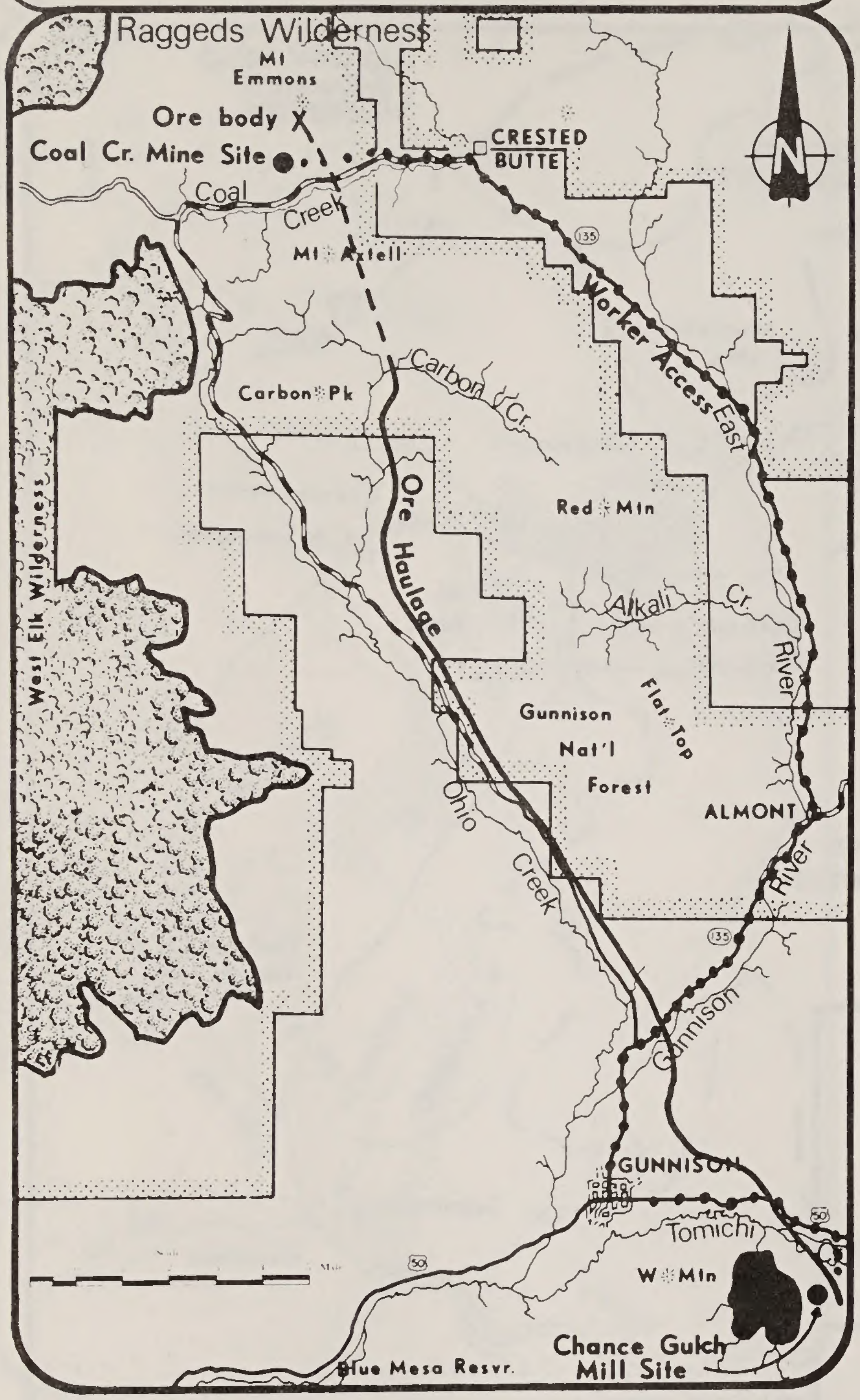
This power supply configuration is the same as in Alternative 5 except that a part of the system is placed underground. Beginning approximately one-half mile east of Kebler Pass and extending to approximately three miles east of Marcellina Mountain, a high pressure, oil-filled electrical transmission pipeline is installed underground.

The system has a normal capacity of 230 kV from the Paonia area to the mine site. The system south to Gunnison has a capacity of 115 kV, with the exception of a short double circuit 230 kV line at the extreme southern end.

The mitigation measures proposed by the Forest Service apply to this alternative.

No land exchange proposal specific to this Alternative has been identified, but it is possible that one would be submitted if the Alternative were to be implemented.

ALTERNATIVE 7


Raggeds Wilderness
Mt Emmons
Ore body
Coal Cr. Mine Site
Coal
Creek
CRESTED BUTTE
N
135
Mt Axtell
Worker Access
East
Carbon Pk
Carbon Cr
Ore Haulage
Red Mtn
Alkali Cr
River
West Elk Wilderness
Gunnison Nat'l Forest
Flat Top
Ohio Creek
ALMONT
River
135
Gunnison
GUNNISON
50
Tomichi
50
W Mtn
Chance Gulch Mill Site
Blue Mesa Resvr.

This alternative involves a Coal Creek mine site and a Chance Gulch mill site. The tailing disposal area is lined to prevent seepage, and tailing is impounded behind an impermeable earth-fill dam.

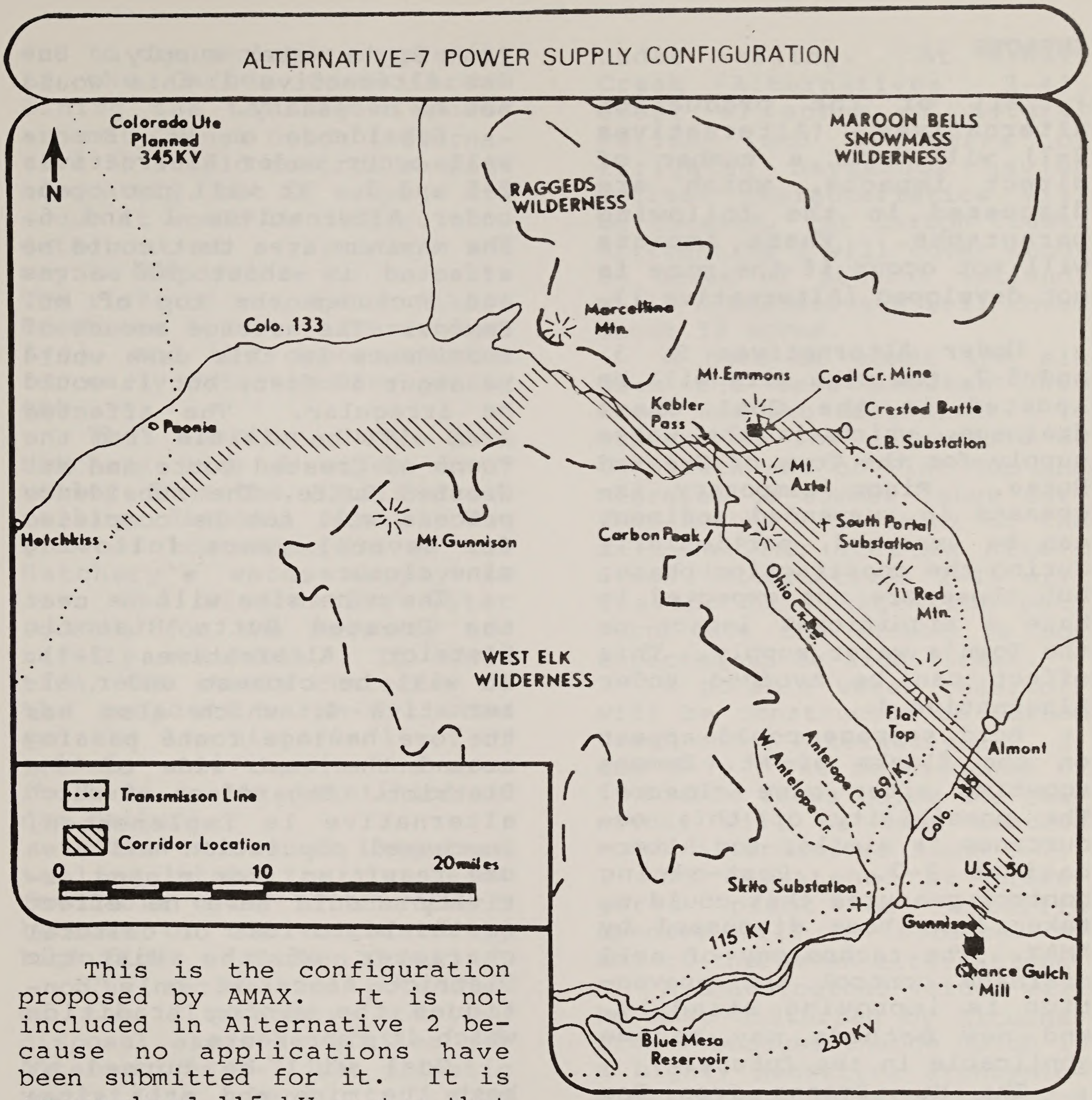
Ore is hauled by rail using diesel-electric locomotives. The route exits from Mt. Emmons down-valley from the mine site, crosses Coal Creek, passes through a 4-mile tunnel under Mt. Axtell, and proceeds southward toward the mill along the Ohio Creek valley. Waste rock taken out of the ore haulage tunnel in Mt. Emmons is hauled to the mine site for disposal. A trestle is used for the Coal Creek crossing.

Approximately 155 million tons of ore are mined at a production rate of 30,000 tons per day. A panel caving method is used, and the project life is about 20 years.

Worker access to the mine is via Colorado 135 along the East River valley with a bypass around the south side of the Town of Crested Butte. Mill access is via U. S. Highway 50 east of Gunnison.

Water for the mill is taken from Tomichi Creek.

Potable water for the mine is stored in a 500 acre-foot reservoir located on Carbon Creek one-half mile east of the south portal of the Mt. Axtell tunnel. If additional water is needed, a second reservoir will be placed on Elk Creek immediately west of the mine site. Potable water for the mill is taken out of Tomichi Creek.



ALTERNATIVE-7 POWER SUPPLY CONFIGURATION

Colorado Ute Planned 345KV
N
RAGGEDS WILDERNESS
MAROON BELLS SNOWMASS WILDERNESS
Marcellina Mtn.
Colo. 133
Mt.Emmons
Coal Cr. Mine
Kebler Pass
Crested Butte
C.B. Substation
Paonia
Mt. Axtel
Hotchkiss
Mt.Gunnison
Carbon Peak
South Portal Substation
Ohio Cr. Rd.
Red Mtn.
WEST ELK WILDERNESS
Flat Top
Almont
W. Antelope Cr.
Antelope Cr.
69 KV
Colo. 135
Transmisson Line
Corridor Location
0
10
20 miles
U.S. 50
Skito Substation
Gunnison
115 KV
Chance Gulch Mill
Blue Mesa Reservoir
230 KV

This is the configuration proposed by AMAX. It is not included in Alternative 2 because no applications have been submitted for it. It is an overhead 115 kV system that begins southeast of Gunnison and passes through the Chance Gulch area. It crosses U.S. Highway 50 east of Gunnison and continues northward, crossing Colorado 135 south of Almont and then passing around the west side of Flat Top to reach the top of Alkali Basin. From there it follows the same route as described in Alternative 2.

The mitigation measures proposed by the Forest Service apply to this alternative.

No land exchange proposal specific to this Alternative has been identified, but it is possible that one would be submitted if the Alternative were to be implemented.

IMPACTS

All of the production alternatives (Alternatives 2-7) will have a number of direct impacts, which are discussed in the following paragraphs. These impacts will not occur if the mine is not developed (Alternative 1).

Under Alternatives 2, 3, and 5-7, the mine site will be located in the Coal Creek drainage, which is the water supply for the Town of Crested Butte. Minor temporary increases in suspended sediment can be expected, particularly during the construction phase, but these are not expected to have a significant impact on the Town's water supply. This effect can be avoided under Alternative 4.

Acid seepage could appear on the flanks of Mt. Emmons sometime after mine closure. The possibility of this occurrance is similar for Alternatives 2-7. Post-mining control measures that could be taken have been discussed by AMAX. The technology of acid drainage control and prevention is improving steadily, and new methods may become applicable in the future.

The Mt. Emmons Iron Bog supports the round-leaf sundew plant. It is not on the rare and endangered species list, but its only known occurrence in Colorado is in this Iron Bog. The bog is fed by acidic metals-rich spring water that has passed through the bedrock of Mt. Emmons. As mining the ore body will locally disrupt groundwater flow patterns in the mountain, the Bog could lose its water source. Under Alternatives 2-7, AMAX will take steps to maintain the Iron Bog's water supply. Under Alternative 1 this would not be necessary.

Subsidence on Mt. Emmons will occur under Alternatives 2-5 and 7. It will not occur under Alternatives 1 and 6. The maximum area that could be affected is about 900 acres and includes the top of Mt. Emmons. The average amount of subsidence in this case would be about 50 feet, but it would be irregular. The affected area will be visible from the Towns of Crested Butte and Mt. Crested Butte. The subsidence process will not be completed for several years following mine closure.

The mine site will be near the Crested Butte Historic District (Alternatives 2-7). It will be closest under Alternative 4, which also has the ore haulage route passing around the east side of the District. Regardless of which alternative is implemented, increased population and area use resulting from mining activity should have no effect on the historical or cultural character of the Historic District since it only continues the mining tradition which it represents.

Coal will be burned at both the mine and mill sites for heating purposes. The Colorado Department of Health has already issued permits for Alternative 2. Air quality modelling for the other alternatives indicates that National Ambient Air Quality Standards will be met. Air quality in the West Elk Wilderness will not be significantly impacted by any of the alternatives.

The risks of seepage from the tailing deposit are greatest under Alternatives 5 and 6 due to the geologic complexity in the Carbon Creek area. Lining the tailing disposal area at Chance Gulch (Alternative 7) should control seepage adequately, but if seepage did occur it would be difficult to detect at an early stage and may be impossible to correct. The risks of seepage at Alkali Creek are lowest (Alternatives 2-4), and the opportunities for early detection are greatest.

The Roaring Judy Fish Hatchery lies 3 miles down-valley from the Alkali Creek tailing disposal area. The risk of contamination of the Hatchery's water supply is low, and alternative water sources for the Hatchery are readily available. In addition, the stable character of the proposed earth-fill dam and the low historic level of seismic activity in the area indicate a low likelihood of dam failure.

Maintenance of long-term tailing stability is least favorable under Alternative 5 because of the comparatively high flows of Carbon Creek.

The reclamation potential of the alternative tailing disposal areas is similar for Alternatives 2-7, but climatic variations lead to some differences. Chance Gulch (Alternative 7) is comparatively dry and has the least favorable climate for tailing area revegetation. Carbon Creek (Alternatives 5 and 6) and Alkali Creek (Alternatives 2-4) have more favorable moisture conditions.

Wetlands will be impacted locally under all alternatives. The most significant impacts will occur under Alternatives 2-6 because of the wetlands that will be buried under tailing. At Alkali Creek (Alternatives 2-4), about 43 acres of natural wetland and 99 acres of irrigated haymeadow having wetland characteristics will be covered. At Carbon Creek, Alternative 5 will cover about 84 acres of natural wetland, while Alternative 6 will cover about 53 acres.

A herd of about 160 elk uses the area between Ohio Creek and the East River. It winters at low elevations on the south end of Flat Top and migrates to summer range further north. Placement of the mill-tailing area in Alkali Creek (Alternatives 2-4) will disrupt this migration pattern, but the effect is not expected to be significant.

A potable water reservoir will be constructed on Carbon Creek under Alternatives 2, 3, and 5-7. The maintenance of favorable flows below the reservoir will be best assured under Alternatives 3 and 5-7.

No threatened or endangered plant or wildlife species will be affected by any of the seven alternatives.

Archaeological values will be most disturbed by Alternative 7 because Chance Gulch is a highly sensitive archaeological area. Alternatives 2-4 will disturb archaeological values the least.

No prime agricultural land will be affected by any of the alternatives.

National Forest timber production will not be significantly affected by any of the alternatives.

Installation of a looped power supply system will create minor visual impacts. Burial of parts of the system through visually sensitive areas (Alternative 6) may moderate some of the effects but may introduce other adverse effects. Alternatives 3 and 4 take the most advantage of existing power line corridors to minimize new corridor construction.

The land exchange proposed by AMAX (Alternative 2) would give the Company maximum control over Project activities. Under Alternative 3, variations on this proposal offer a chance to resolve a number of resource conflicts in the public sector and, at the same time, maintain the NFS resource base.

In addition to the direct effects summarized above, a number of indirect impacts will also occur. These are discussed in the following paragraphs.

Under Alternative 1, the Gunnison area is expected to experience a 2-4 percent annual growth in population.

Rapid population growth is anticipated under Alternatives 2-7, but even under Alternative 1 growth problems will exist. Alternatives 2-7 are similar in that the types of growth pressures will be the same, differing mainly in degree. They will all require significant increases in housing, school capacity, and wastewater treatment capacity, to name only a few. The growth center will be the city of Gunnison. Among Alternatives 2-7, Alternative 6 will require the least local adjustment to growth, but it also involves the shortest Project life and will bring mine closure within 12 years of the rapid growth period.

Housing construction may impact natural wetlands, with the highest chance of impact coming under Alternatives 2-5 and 7.

The impacts of local population growth on big game due to general harassment and winter range lost to urban development are likely to be greater than from any direct impacts. Thus, Alternatives 2-5 and 7 will have the most impact.

Population growth will lead to an increase in secondary air emissions, which will be greatest under Alternatives 2-5 and 7, and least under Alternative 1.

Outdoor recreation activities will increase under all alternatives, with Alternatives 2-5 and 7 generating the most increase and Alternative 1 the least. However, the differences between alternatives are small compared to the overall level of recreation use generated by visitors from other areas.

Under all alternatives, demand for electricity is expected to rise due to population growth. Some improvements are likely to be added before 1995 to make more power available.

If the mine is not developed (Alternative 1), the 682,000 tons of molybdenum disulfide (over 817 million pounds of molybdenum metal) in the Mt. Emmons ore body will not contribute to the world supply of molybdenum. Economic benefits (local, statewide, and national) of mining and processing the mineral deposit will not occur. These benefits include an increase in the local tax base, increased employment, payment of Colorado severence taxes totalling $23.25 million, and exports to foreign countries.

Under the Small Mine alternative (Alternative 6), 117 million tons of the ore body identified by AMAX would be left in place and would probably become unminable. This tonnage would be extracted under the other production alternatives (Alternatives 2-5, and 7).

TABLE OF CONTENTS

TABLE OF CONTENTS

LIST OF FIGURES xxvi
LIST OF TABLES xxviii

CHAPTER 1. PURPOSE AND NEED. 1
- Purpose and Need 1
- Project Summary 1
- Project Decisions 2
- Project History 3
- Uses of Molybdenum 6
- Microfiche Reference System 6

CHAPTER 2. ALTERNATIVES INCLUDING THE PREFERRED ALTERNATIVE 9
- Introduction 9
- Structure of Alternatives 9
- Description of Alternatives 11
- Comparison of Alternatives. 28
- Forest Service Preferred Alternative. 37
- Alternatives Eliminated from Detailed Study 38

CHAPTER 3. AFFECTED ENVIRONMENT 45
- Vegetation 45
- Wildlife 50
- Aquatic Ecology 53
- Energy 54
- Water 56
- Air 63
- Noise 65
- Cultural Resources 65
- Visual Resources 66
- Outdoor Recreation 68
- Fire 74
- Transportation 74
- Socioeconomic 75
- Geology 90
- Soils 94
- Land Uses 95
- Avalanche Hazards 97

- CHAPTER 4. ENVIRONMENTAL CONSEQUENCES . . . 99
  - General Impacts . . . 100
    - Vegetation . . . 101
    - Wildlife . . . 104
    - Aquatic Ecology . . . 106
    - Energy . . . 106
    - Water . . . 108
    - Air . . . 110
    - Noise . . . 112
    - Cultural Resources . . . 112
    - Visual Resources . . . 114
    - Outdoor Recreation . . . 116
    - Fire . . . 121
    - Transportation . . . 121
    - Socioeconomic . . . 124
    - Geology . . . 126
    - Soils . . . 127
    - Land Uses . . . 127
    - Avalanche Hazards . . . 129
  - Mine Site . . . 129
    - Coal Creek . . . 129
      - Site Impacts . . . 129
      - Worker Access Impacts . . . 138
    - Slate River . . . 142
      - Site Impacts . . . 142
      - Worker Access Impacts . . . 147
  - Mill Site . . . 149
    - Alkali Creek . . . 149
      - Site Impacts . . . 149
      - Ore Haulage Impacts . . . 161
      - Worker Access Impacts . . . 169
    - Carbon Creek . . . 173
      - Site Impacts . . . 173
      - Ore Haulage Impacts . . . 173
      - Worker Access Impacts . . . 179
    - Chance Gulch . . . 182
      - Site Impacts . . . 185
      - Ore Haulage Impacts . . . 185
      - Worker Access Impacts . . . 191
  - Production Rate . . . 197
    - Vegetation . . . 200
    - Wildlife . . . 201
    - Aquatic Ecology . . . 201
    - Energy . . . 201
    - Water . . . 203
    - Air . . . 203
    - Noise . . . 208
    - Cultural Resources . . . 209
    - Visual Resources . . . 209
    - Outdoor Recreation . . . 209
    - Fire . . . 209
    - Transportation . . . 209
    - Socioeconomic . . . 209

Geology. 219
Soils. 219
Land Uses. 219
Avalanche Hazards. 219
Power Supply. 219
Power Source 219
Voltage. 223
Overhead Transmission Lines. 223
Combination of Systems 229
System Location. 232
Land Exchange 237
General Selected Land Impacts. 237
Coal Creek Mine Site 237
Slate River Mine Site. 238
Alkali Creek Mill Site 238
Carbon Creek Mill Site 239
Chance Gulch Mill Site 239
General Offered Land Impacts 239
Land Classification 239
Resource Characteristics 240
Advantages to the United States. 246
Disadvantages to the United States 247
Other Impacts 248
Local Source Materials 248
Potable Water. 249
Coal Creek Watershed 251
The Relationship Between Short-Term Uses of Man's Environment and the Maintenance and Enhancement of Long-Term Productivity 252
Irreversible and Irretrievable Commitments of Resources. 254
Cumulative Impacts 256

CHAPTER 5. LIST OF PREPARERS 257
Primary DEIS Preparers. 257
Consultation and Coordination 259

APPENDICES

Appendix A. AMAX's Mitigation, Avoidance, and Enhancement Measures 261
Appendix B. Mitigation Measures 301
Appendix C. Project Layout Details 327
Appendix D. Power Supply Details 345
Appendix E. Land Classification Details 353
Appendix F. Land Exchange Details 365
Appendix G. Project Schedule 374
Appendix H. Reference Guide for Issue Analysis 375
Appendix I. Methodology 379
Appendix J. Statement Distribution. 387

GLOSSARY 397
BIBLIOGRAPHY 413
INDEX 427

LIST OF FIGURES

Figure | Page

1-1 Mount Emmons Area. 2
2-1 Alternative Design 10
2-2 Lands AMAX Proposes to Acquire 15
2-3 Lands AMAX Proposes to Offer to the Forest Service . . . 17
3-1 Mount Emmons Iron Bog. 48
3-2 Aspen "Fingers" on Red Mountain are a Major Big Game Migration Path. 48
3-3 Discharge of Local Streams 57
3-4 Project Area TSP 64
3-5 Ambient Noise Levels 65
3-6 Visual Quality Objectives in the Horse Ranch Park Area . 67
3-7 Upper Gunnison Basin 69
3-8 Project Area Recreation. 70a
3-9 Projected Outdoor Recreation 73
3-10 Total Gross Output Without Mount Emmons. 85
3-11 General Geology of the Gunnison-Crested Butte Area . . . 91
3-12 Geology of Mount Emmons. 92
3-13 Geology of Alternative Tailing Disposal Areas. 92a
3-14 Avalanche Hazards. 97a
4-1 Projected Subsidence Boundaries. 117
4-2 Maximum Limit of Subsidence on Mount Emmons. 118
4-3 Outdoor Recreation at 20,000 Tons Per Day. 119
4-4 Particulate and Fugitive Emissions from the Coal Creek Mine Site 133
4-5 Particulate and Fugitive Emissions from the Alkali Creek Mill Site 155
4-6 Predicted Energy Consumption in the Gunnison Basin with 10,000 Ton Per Day Mine. 203
4-7 Predicted Energy Consumption in the Gunnison Basin with 20,000 Ton Per Day Mine 204
4-8 Predicted Energy Consumption in the Gunnison Basin with 30,000 Ton Per Day Mine 204
4-9 Air Quality from Secondary Emission Sources at 10,000 Tons Per Day 206
4-10 Air Quality from Secondary Emission Sources at 20,000 Tons Per Day 207
4-11 Air Quality from Secondary Emission Sources at 30,000 Tons Per Day 208
4-12 Employee Requirements for Alternative Production Rates . 211
4-13 Gunnison County Population Under Alternative Production Rates 212
4-14 City of Gunnison Population Under Alternative Production Rates 212a
4-15 New Housing Units Needed Under Alternative Production Rates 214a

Figure Page

4-16 Estimated School Enrollment in Gunnison Watershed School District Under Alternative Production Rates. 216a
4-17 Total Gross Output with Mount Emmons at 20,000 Tons Per Day 216a
4-18 Estimated Electrical Demands in the Gunnison County Electric Assn. Service Area Compared to Transmission Capacity and Available Supplies 220
4-19 Typical Clearing for Overhead Transmission Line. 224
4-20 View of Right-Of-Way Pattern and Conductor Sway Factor . 225
4-21 Typical Clearing for Underground Transmission Lines. . . 230
C-1 Alternative Mine Site Locations. 329
C-2 Coal Creek Mine Site Plan. 333
C-3 Slate River Mine Site Plan 334
C-4 View of Alkali Creek Mill/Tailings Site Area 335
C-5 View of Carbon Creek Mill/Tailings Site Area 335
C-6 View of Chance Gulch Mill/Tailings Site Area 335
C-7 Alkali Creek Tailing Disposal Area 336
C-8 Alkali Creek Earthfill Dam (Typical) 337
C-9 Alkali Creek Mill Site Plan. 338
C-10 Typical Electric Rail System 339
C-11 Coal Creek Crossing. 340
C-12 South Portal of the Mount Axtell Tunnel and Carbon Creek Potable Water Reservoir. 340
C-13 Carbon Creek Mill Site Plan. 341
C-14 10,000 Ton Per Day Alternative 342
C-15 Typical Conveyor System. 343
C-16 Chance Gulch Mill Site Plan. 344
D-1 Possible Power Sources, Corridor Analysis and Major Environmental Constraint Areas 351
D-2 Alternative Transmission Line Corridors. 352
E-1 Arapahoe-Roosevelt National Forest Present Classification 355
E-2 Gunnison National Forest Present Classification. 356
E-3 Gunnison National Forest Present Classification. 357
E-4 San Juan National Forest Present Classification. 358
E-5 White River National Forest Present Classification . . . 359
E-6 Arapahoe-Roosevelt National Forest Proposed Classification 360
E-7 Gunnison National Forest Proposed Classification 361
E-8 Gunnison National Forest Proposed Classification 362
E-9 San Juan National Forest Proposed Classification 363
E-10 White River National Forest Proposed Classification. . . 364
F-1 Lands Near Gunnison in Gunnison County which AMAX Proposes to Offer to the Forest Service. 370
F-2 Lands Near Kebler Pass and Blue Mesa Reservoir in Gunnison County Which AMAX Proposes to Offer to the Forest Service 371
F-3 Coal Creek Mine Site Exchange Alternatives 372
F-4 Alkali Mill Site Exchange Alternatives 373

LIST OF TABLES

Table | Page

1-1 Cooperation Agency Decision. 4
2-1 Project Alternatives 11
2-2 Land Exchange Acres. 16
2-3 Comparison of Power Supply Configurations. 35
2-4 Power Corridor Suitability 35
3-1 Vegetation Types in the Project Area 46
3-2 Regional Comparison of Per Capita Energy Consumption (1977-1978) 55
3-3 Potential Recreation Area. 71
3-4 Current and Projected Population in Gunnison County. . . 77
3-5 Per Capita Income. 79
3-6 Income Distribution in 1974. 79
3-7 Annual Average Employment by Sector in the Gunnison Trade Area. 80
3-8 Assessed Valuations in Gunnison County 82
3-9 Soil Reclamation Potential 95
3-10 Gunnison County Land Ownership, 1979 96
4-1 Potential Vegetation Disturbance from Subsidence of Mount Emmons. 101
4-2 Potential Wildlife Impacts from Subsidence of Mount Emmons. 105
4-3 Air Quality in the West Elk from the Emissions at Alkali Creek Milling Facility 111
4-4 Average Daily Traffic Volume 122
4-5 Capacity vs. Projected Volumes 123
4-6 Projected Colorado Highway 135 Accidents 124
4-7 Acres of Potential Vegetation Disturbance: Coal Creek Mine Site 130
4-8 Index of Potential Wildlife Impacts: Coal Creek Mine Site 131
4-9 Mine Site Emission Sources 134
4-10 Point Source Gaseous Emissions from Mining Facilities. . 134
4-11 Maximum Concentrations of Point Source Emissions: Coal Creek Mine Site 135
4-12 Maximum Potential Ambient Concentrations of Colorado Designated Hazardous Pollutants 135
4-13 Worker Transportation Energy Consumption: Both Mine Sites 141
4-14 Acres of Potential Vegetation Disturbance: Slate River Mine Site 142
4-15 Index of Potential Wildlife Impacts: Slate River Mine Site 143
4-16 Maximum Concentrations of Mine Exhaust Emissions in the Coal Creek Valley. 144
4-17 Maximum Concentrations of Point Source Emissions: Slate River Mine Site 145
4-18 Acres of Potential Vegetation Disturbance: Alkali Mill Site 150
4-19 Index of Potential Wildlife Impacts: Alkali Mill Site. . 150
4-20 Mill-Tailing Area Emission Sources 156

Table | Page

4-21 Point Source Gaseous Emissions from Milling Facilities . 156
4-22 Predicted Maximum Concentrations from Point Source Emissions: Alkali Creek Mill. 157
4-23 Mineralogy of Mount Emmons Ore and Tailing Samples . . . 157
4-24 Acres of Potential Vegetation Disturbance: Ore Haulage to the Alkali Creek Mill. 161
4-25 Index of Potential Wildlife Impacts: Ore Haulage to the Alkali Creek Mill 162
4-26 Energy Requirements Ore Haulage to the Alkali Creek Mill. 164
4-27 Capital Cost of Ore Haulage Routes to the Alkali Creek Mill. 168
4-28 Worker Transportation Energy Consumption: Alkali Creek Mill. 171
4-29 Acres of Potential Vegetation Disturbance: Carbon Creek Mill Site 173
4-30 Index of Potential Wildlife Impacts: Carbon Creek Mill Site 174
4-31 Maximum Concentrations from Point Source Emissions: Carbon Creek Mill 177
4-32 Acres of Potential Vegetation Disturbance: Ore Haulage to Carbon Creek Mill. 179
4-33 Index of Potential Wildlife Impacts: Ore Haulage to the Carbon Creek Mill. 180
4-34 Worker Transportation Energy Consumption: Carbon Creek Mill. 183
4-35 Acres of Potential Vegetation Disturbance: Chance Gulch Mill Site 185
4-36 Index of Potential Wildlife Impacts: Chance Gulch Mill Site 187
4-37 Predicted Maximum Concentrations from Point Source Emissions: Chance Gulch Mill. 189
4-38 Grazing Reduction from Construction of the Chance Gulch Mill. 191
4-39 Acres of Potential Vegetation Disturbance: Ore Haulage to the Chance Gulch Mill. 192
4-40 Index of Potential Wildlife Impacts: Ore Haulage to the Chance Gulch Mill 193
4-41 Energy Requirements of Ore Haulage to the Chance Gulch Mill. 195
4-42 Capital Cost of Haulage to the Chance Gulch Mill 197
4-43 Worker Transportation Energy Consumption: Chance Gulch Mill. 198
4-44 Acres of Potential Vegetation Disturbance: Carbon Creek Mill Site (Alternative 6) 201
4-45 Predicted Energy Consumption: Alternatives 2-5. 202
4-46 Percent Growth in Gunnison County. 212
4-47 Percent Growth in the City of Gunnison 212a
4-48 Spatial Allocation of Residents in 1994. 214
4-49 Gunnison Watershed School District Requirements 1981-1994 215
4-50 Public Service Requirements. 216

Tables Pages

4-51 Environmental and Engineering Factors Used For Suitability Index Determination 233
4-52 Alternative Transmission Line Segment Suitability Indices 234
4-53 Acres of Potential Vegetation Disturbance: Potable Water Supplies. 250
C-1 Mine Site Structures 327
C-2 Mill Site Structures 328
D-1 Existing and Planned Transmission Lines. 349
D-2 Power Supply System Structures 349
D-3 Typical Material Requirements for High Voltage Transmission Systems. 350
F-1 Land Exchange Proposal: Acreage by Ownership 369
I-1 Wildlife Impact Index Calculations Sagebrush Habitat . . 382
I-2 Mount Emmons Project Area Wildlife Habitat Value Indexes 382
I-3 Wildlife Habitat Relationships Analysis Species List for the Mount Emmons Project by Special Needs Capability. 383
I-4 Wildlife Habitat Relationships Analysis Species List for the Mount Emmons Project by Vegetation Type Habitat Capability Coefficient. 385

CHAPTER 1. PURPOSE AND NEED

CHAPTER 1. PURPOSE AND NEED

Page Reference

Purpose and Need 1
Project Summary 1
Project Decisions 2
Project History 3
Uses of Molybdenum 6
Microfiche Reference System 6

PURPOSE AND NEED

This draft Environmental Impact Statement (EIS) has been prepared by the Forest Service in response to the application by AMAX Inc. to construct and operate a molybdenum mining and milling complex, called the Mt. Emmons Project, partly on National Forest System (NFS) land within Gunnison National Forest in Gunnison County, Colorado. Various federal officials will make decisions regarding the project.

This draft EIS documents an environmental analysis of AMAX's proposal and of reasonable alternatives to it. It was prepared in accordance with Section 102(2)(C) of the National Environmental Policy Act of 1969 (NEPA) and subsequent regulations promulgated by the Council on Environmental Quality (40 CFR Parts 1500-1508).

An EIS is not a decision document. It is a document disclosing the environmental consequences of implementation of the proposed action and alternatives to the proposed action. It is an important document for Federal, State, and local governments to use in arriving at their individual decisions regarding the proposed action and alternatives to it.

PROJECT SUMMARY

The ore body lies under Mt. Emmons, which rises immediately west of the Town of Crested Butte (Figure 1-1). Portions of the ore body underlie patented mining claims, while the remainder underlie NFS lands.

AMAX's proposal involves the following facilities: (a) a mine site on Mt. Emmons in the Coal Creek drainage; (b) a mill site and tailing disposal area in the Alkali Creek area twelve miles southeast of the ore body; (c) a rail ore haulage system; (d) major access roads; and (e) overhead transmission lines connecting the project with two independent sources (one located near Gunnison and one near Paonia). Both private and federal lands are involved.

As proposed, the project will produce approximately 20,000 tons of ore per day and about 63 million pounds of molybdenum disulfide (MoS_2) concentrate per year. The life of the mine will be approximately 30 years. The current schedule generally calls for construction to begin in the mid-1980's, with full production being reached in the late-1980's or early-1990's. Additional schedule details can be found in Appendix G.

A Plan of Operations (AMAX, 1979a) was submitted to the Forest Service by AMAX on May 18, 1979, in accordance with the Forest Service's mining regulations in 36 CFR 252 (1980) recodified at 36

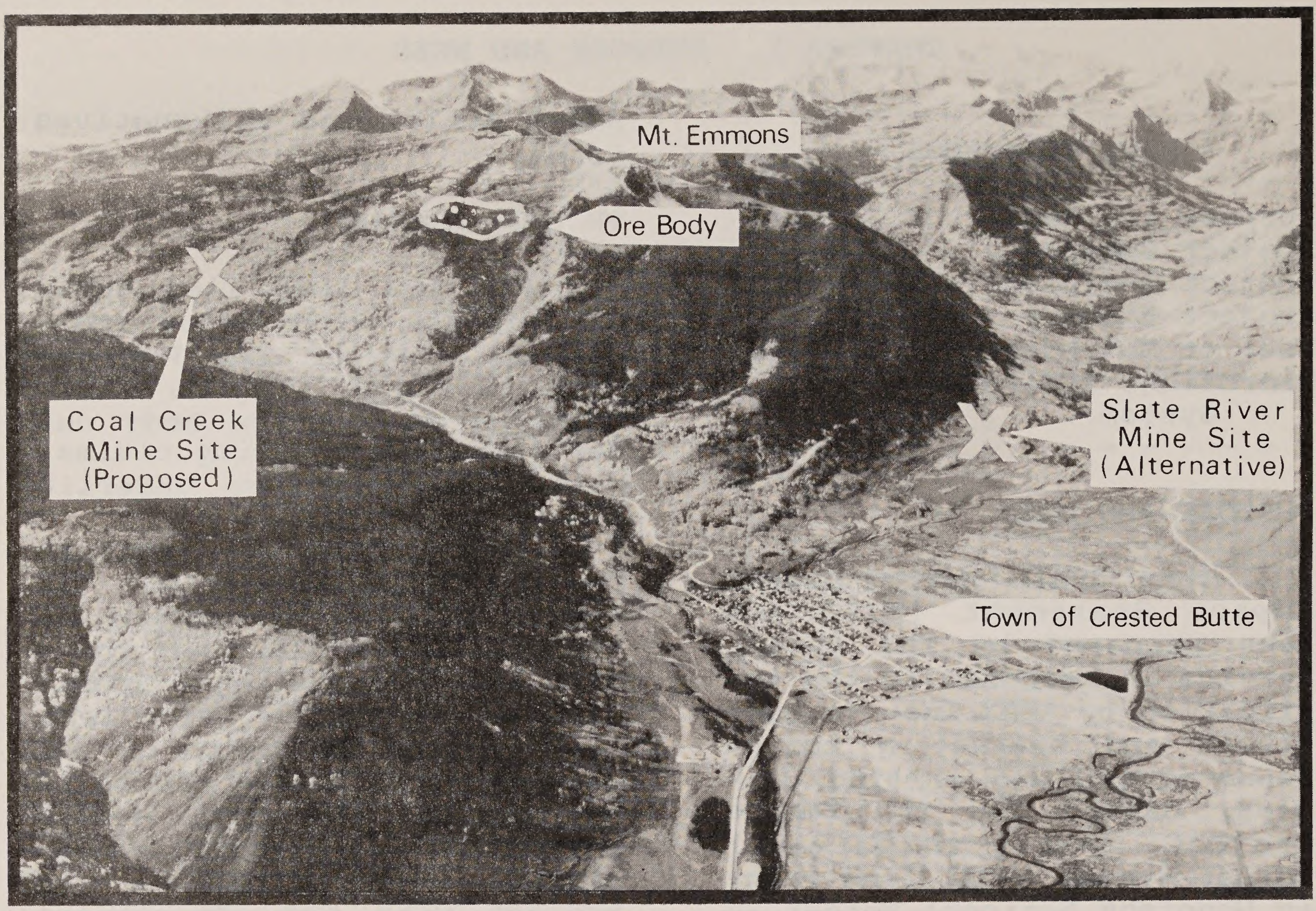

Mt. Emmons
Ore Body
Coal Creek Mine Site (Proposed)
Slate River Mine Site (Alternative)
Town of Crested Butte

Figure: 1-1 MT. EMMONS AREA

CFR 228 (46 FR 36142, July 14, 1981). Subsequent revisions were submitted in 1980 and 1981 (AMAX, 1980a and 1981a, respectively). For portions of the proposed ore haulage system, AMAX has applied for an easement (AMAX, 1981d) in accordance with the Forest Service's regulations implementing the Federal Land Policy and Management Act of 1976 (FLPMA, 43 U.S.C. 1716). In addition, AMAX has proposed a land exchange to obtain title to certain lands affected by the Project.

Gunnison County Electric Association (GCEA) has applied for easements for overhead transmission lines to serve the Project. This application was submitted under the Forest Service's regulations implementing FLPMA.

PROJECT DECISIONS

The Forest Service must make several decisions regarding the Project, as described below:

(1) A decision will be made identifying the Plan of Operations that is approved. This will detail the manner in which AMAX is authorized to operate on its unpatented mining and milling claims on NFS lands. The decision on this approval will be made under the authority of the Forest Service's mining regulations.

(2) Decisions will be made on granting easements for the construction and operation of the ore haulage system and transmission lines when on NFS lands that are not on AMAX's unpatented claims. These de-

cisions will be done under the authority of FLPMA.

(3) A decision on the proposed land exchange will be made by the Chief of the Forest Service, with oversight review by the House Interior Subcommittee on Public Lands. This decision will be made under the authorities of the General Exchange Act of March 20, 1922, and FLPMA.

The responsible official will use this document, in part, in making these decisions. A Record of Decision documenting the decision will be prepared in accordance with the Council on Environmental Quality regulations (36 CFR 1505.2). The Record of Decision will include a discussion of the relevant factors and essential considerations which were balanced in making the decision and state how those considerations entered into the decision.

The environmental consequences on lands and activities administered by other Federal, State, and local jurisdictions resulting from the proposed action are disclosed in this DEIS. Through cooperation, other Federal, State, and local jurisdictions have assisted in the disclosure of environmental consequences and the development of alternatives to the proposed action.

The Forest Service decisions will relate only to lands administered by the Forest Service and will be documented in a Record of Decision. Decisions by other jurisdictions to issue or not issue approvals related to this proposal can be made by them based on the disclosure of impacts available in this document.

Table 1-1 lists the cooperating agencies in the preparation of this document and, to our knowledge, the approvals from them needed by AMAX.

PROJECT HISTORY

AMAX initiated exploratory drilling on the slopes of Mt. Emmons in 1976. Discovery of molybdenum disulfide mineralization led to more drilling in 1977. AMAX subsequently announced the discovery of approximately 155 million tons of ore averaging 0.43 percent molybdenum disulfide.

Following confirmation of the ore deposit, AMAX inventoried and evaluated several mine and mill-tailing sites in the area. The results of this process were made available to the Forest Service and the public during the period 1977 to 1979. In all, 29 mill-tailing complexes were studied. A number of these sites had characteristics which, by company standards, were considered undesirable. In early 1978, AMAX selected four preferred sites and established a study area within which more detailed analysis was begun covering mining, geologic, and environmental information. Based on the information gathered, AMAX eventually settled on the Alkali Creek area as its preferred mill-tailing location.

On May 18, 1979, AMAX submitted a Plan of Operations to the Forest Service (AMAX, 1979a). This plan covered the basic layout of the Project and was submitted under the Forest Service's mining regulations. Subsequent revisions were made in 1980 and 1981 (AMAX, 1980a, 1981a). These

TABLE 1-1 COOPERATION AGENCY DECISIONS

Federal Agency	Action	Activities Affected
Bureau of Land Management	Issuance of Right-of-Way Permit(s)	Power lines, access roads, haulage corridors, and other support facilities on Public lands
Bureau of Land Management	Land Exchange	Millsite and tailings disposal areas
Bureau of Land Management	Archaeological clearance (with concurrence of the State Historic Preservation Officer)	All surface disturbance activities
Department of Army Corps of Engineers	Issuance of 404 Dredge and Fill Permit(s) *	Construction activities affecting major waterways or wetlands
Environmental Protection Agency	Review approval of State-issued National Pollutant Discharge Elimination System (NPDES) permit(s)	Mine, mill, and other point source discharges
Environmental Protection Agency	Issuance of Prevention of Serious Deterioration (PSD) Permit	Air emission discharges from project activities
Environmental Protection Agency	Resource Conservation Recovery Permit	Treatment, storage, and disposal of hazardous wastes
Environmental Protection Agency	Review of issuance of 404 Dredge and Fill Permits	Construction activities affecting major waterways or wetlands
Bureau of Reclamation	Approval of contract for use of water appropriated for the Blue Mesa Project	Consumption of water appropriated for the Blue Mesa Project
Rural Electrification Administration	Approval of power sales and construction contracts	Power transmission line construction
Western Area Power Administration	Approval of agreements to wheel power over transmission lines	Power transmission line construction

Gunnison County	Action	Activities Affecting
Gunnison County	Approve plans for disposal of mine waste and general refuse	Disposal of all mine waste and general refuse
Gunnison County	Approve land use change	All project activities and facilities
Gunnison County	Issue building permits	All construction
Gunnison County	Issue plumbing and heating permits	All plumbing and heating installations

* AMAX's applications for 404 Permits for its proposed project design were submitted to the Corps during the final stages of this DEIS's preparation. The details of these applications can be found in AMAX (1981b), which is incorporated by reference.

TABLE 1-1 (Continued)

Colorado Agency	Action	Activities Affected
Dept. of Health, Air Pollution Control Division	Issue Emission Permits	Air emissions from project facilities and activities
Dept. of Health, Air Pollution Control Division	Issue Fugitive Dust permits	Fugitive dust from project activities
Dept. of Health, Air Pollution Control Division	Issue Open Burning permits	Open burning
Dept. of Health, Water Quality Control Division	Issue NPDES Permit	Mine, mill, and other point source discharges
Dept. of Health, Water Quality Control Division	Issue water quality certification	Construction activities affecting major waterways or wetlands
Dept. of Health, Water Quality Control Division	Certify sewage treatment plant operators	Sewage treatment plant operations
Dept. of Health, Water Quality Control Division	Approve sewage treatment plant siting and construction	Sewage treatment plant construction
Dept. of Health, Water Quality Control Division	Approve potable water supply systems	Potable water supply sytems
Dept. of Health, Radiation and Hazardous Waste Control Division	Recommend to County Commissioners on approval of Solid Waste Certificate	Disposal of solid waste
Dept. of Natural Resources, Mined Land Reclamation Division	Issuance of Mining Permit	Mining and Milling operations and reclamation
Dept. of Natural Resources, Div. of Water Resources	Issue well and pump permits	All wells
Dept. of Natural Resources, Div. of Water Resources	Approve change of permits	Changes of water use
Dept. of Natural Resources, Div. of Water Resources	Approve reservoir and dam plans	Construction of dams over 10 feet in height
Dept. of Highways	Issue permits granting access, utilities right-of-way, and oversize highway use	Activities affecting State highways
Colorado State Inspector of Oils	Approve storage of liquified petroleum gas	Storage of liquid petroleum gas
State Historic Preservation Officer	Concurs on archaeological clearances	All surface disturbance activities

documents have been available to the public.

In July, 1981, AMAX released its Environmental Report on the Project (AMAX, 1981a). This three-volume document displayed the details of AMAX's proposal, along with the impacts expected from it and from the alternatives being analyzed by the Forest Service.

The Forest Service published a Notice of Intent to prepare an EIS in the Federal Register on December 4, 1978 (43 FR 56669). Late in 1979 and early in 1980, an early and open process was followed for determining the scope of the issues to be addressed in the EIS and for identifying the significant issues related to the Project, as specified in 40 CFR 1501.7.

A notice was published in the Federal Register on December 12, 1979 (44 FR 71853) announcing a series of scoping meetings on the Project. A scoping paper (Forest Service, 1979b) which is incorporated by reference, was distributed to interested parties and affected federal, state, and local agencies. An amendment to the scoping paper (Forest Service, 1980a) was distributed following the scoping meetings. These documents determined the scope and the issues to be analyzed in depth in the EIS. Additional information on these issues is in Appendix H.

Letters were sent to affected Federal agencies inviting their participation in the project based on their jurisdictions and expertise.

The original schedule for completion of the EIS was published in the Federal Register on June 1, 1979 (44 FR 31687). Subsequent revisions were announced on October 7, 1980 (45 FR 68981) and on September 11, 1981 (46 FR 45404).

The Mt. Emmons Colorado Joint Review Process (CJRP) was formally initiated on June 28, 1978, by the signing of a Joint Statement by representatives of the Forest Service, Colorado Department of Natural Resources, and Gunnison County. Through a series of regular public meetings, CJRP provided a forum for the exchange, discussion, and dissemination of Project-related information. The roles of affected Federal, State, and local agencies were clarified in a Statement of Responsibilities assembled by the Colorado Joint Review Process for the Project (CJRP, 1980).

USES OF MOLYBDENUM

Molybdenum is a metal that is used as an additive in steels, cast irons, and super alloys. It is also used as a refractory metal and a lubricant. About 70 percent of its consumption is attributable to the production of molybdenum-containing steels. Additional information can be found in Kummer (1979).

MICROFICHE REFERENCE SYSTEM

The size and complexity of the Mt. Emmons Project has generated approximately 40,000 pages of information pertinent to this draft EIS. It is impractical to include most of this information here, yet it needs to be available for proper public scrutiny. Therefore a microfiche reference system was devised. The Forest Service initiated a cooperative agreement with AMAX to create the system and better inform the public in a cost-effective manner. The microfiche system allows quick scanning of the volumes of material pertinent to this draft EIS in order to make printed copies of only the material of interest.

All of the material incorporated by reference in this draft EIS is available through the system. Complete sets of microfiche have been placed in the following locations for on-premise use.

Forest Service Offices

USDA Forest Service
Washington Office
South Building
12th and Independence S.E.
Washington, D.C. 20013

USDA Forest Service
Regional Office - Denver
11177 W. 8th Avenue
Lakewood, CO 80225

USDA Forest Service
Regional Office -
San Francisco
630 Sansom Street
San Francisco, CA 94111

Grand Mesa, Uncompahgre, and
Gunnison National Forests
Supervisor's Office
1063 Main Street
Delta, CO 81416

Taylor River Ranger District
216 N. Colorado Ave.
Gunnison, CO 81230

Libraries

Denver Public Library
1357 Broadway
Denver, CO 80203

Morgan Library
Colorado State University
Fort Collins, CO 80523

Norlin Library
University of Colorado
Campus Box 184
Boulder, CO 80309

Jefferson County Library
10200 W. 20th Avenue
Lakewood, CO 80215

Savage Library
Western State College
Gunnison, CO 81230

AMAX Offices

Golden Office
1707 Cole Boulevard
Golden, CO 80401

Gunnison Office
126 N. Main Street
Gunnison, CO 81230

Microfiche readers are available at the above locations, and hard copy printers can be found at many of them.

Copies of the Microfiche Master File may be obtained directly from Dakota Graphics, Inc., 9655 W. Colfax Avenue, Lakewood, Colorado 80215, (303) 237-0408. A price list is available upon request.

Further information concerning prices and the use of the microfiche system can be obtained by contacting:

Mt. Emmons ID Team Leader
U. S. Forest Service
216 N. Colorado Ave.
P.O. Box 1089
Gunnison, CO 81230
(303) 641-0471

CHAPTER 2. ALTERNATIVES INCLUDING THE PREFERRED ALTERNATIVE

CHAPTER TWO: ALTERNATIVES INCLUDING THE PROPOSED ACTION

PAGE REFERENCE

Introduction 9
Structure of Alternatives 9
Description of Alternatives 11
Comparison of Alternatives 28
Forest Service Preferred Alternative 37
Alternatives Eliminated From Further Detailed Study 38

INTRODUCTION

This Chapter describes the alternatives analyzed in this draft EIS and, based on the information and analyses contained in Chapters 3 and 4, presents in comparative form the environmental impacts of AMAX's proposal and the alternatives to it. Chapters 3 and 4 contain information essential to a full understanding of the comparisons.

This chapter also describes the alternatives which were eliminated from further detailed study, including a brief discussion of the reasons for their having been eliminated.

The Mt. Emmons Project is complex. AMAX's proposal could be reasonably modified into a large number of alternatives, as indicated by Figure 2-1. For example, either of the two mine sites can be combined with any of the three mill-tailing sites; for most combinations, ore can be hauled by more than one route. Further, workers can reach most of the mine and mill sites by two different routes. Alternative power supply configurations are also involved.

Under these circumstances, the Council on Environmental Quality (CEQ, 1981) suggests that an EIS analyze and compare only a reasonable number of examples covering the full spectrum of alternatives. The Forest Service adopted this approach in developing the alternatives analyzed in detail in this draft EIS.

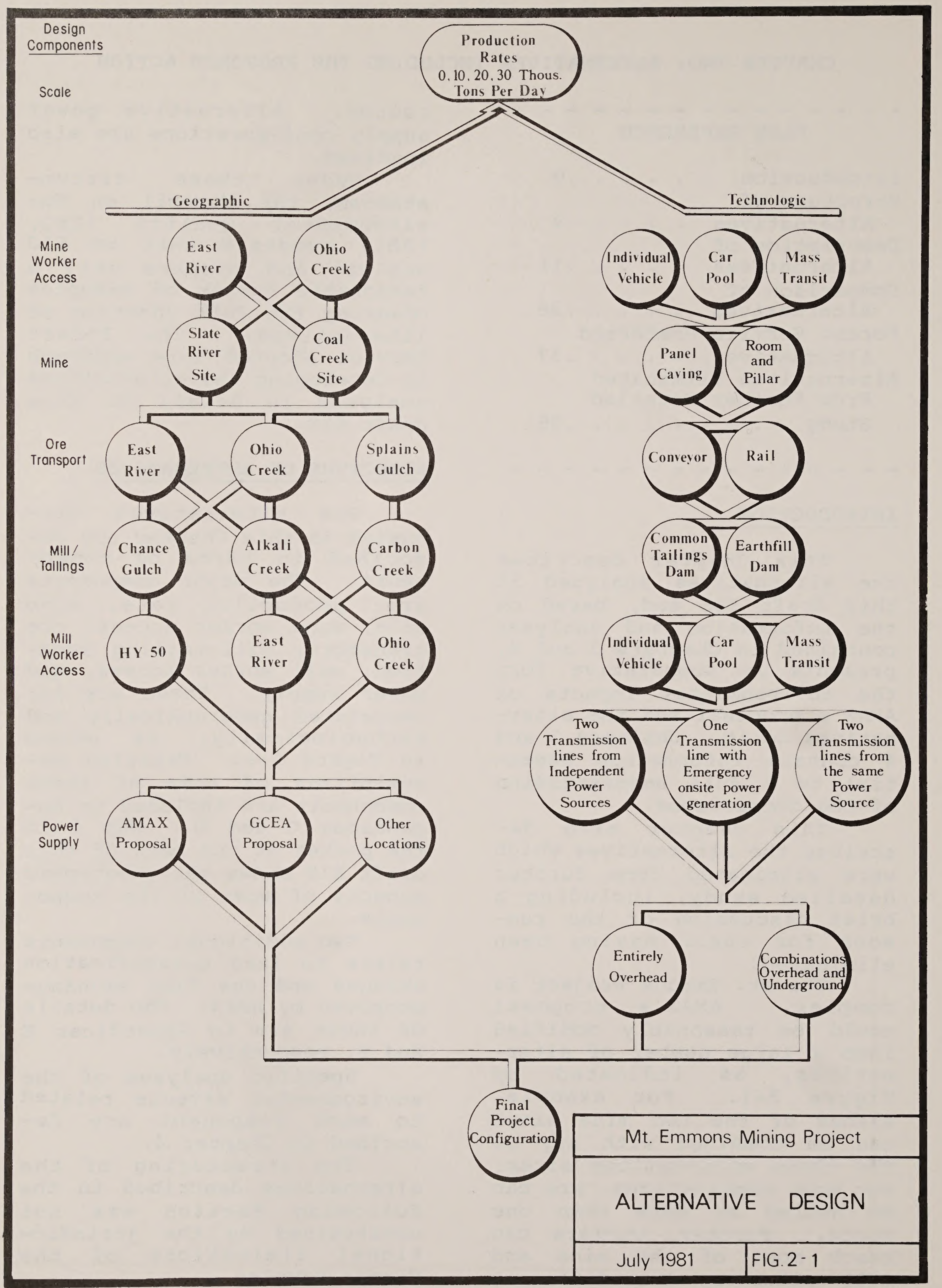
STRUCTURE OF ALTERNATIVES

The alternatives discussed in this Chapter are described in terms of components. The major components are: production rate, mine site, mine worker access, ore transport, mill-tailing location, mill worker access, and power supply. These are interrelated geographically and technologically, as shown in Figure 2-1. Detailed descriptions of some of these components are included in Appendices C and D. Map 1 in the pocket at the back of this draft EIS shows the geographic aspects of most of the components.

Two additional components relate to land classification changes and the land exchange proposed by AMAX. The details of these are in Appendices E and F, respectively.

Specific analyses of the environmental effects related to each component are described in Chapter 4.

The structuring of the alternatives described in the following Section was not constrained by the jurisdictional limitations of the Forest Service.


Design Components
Scale
Production Rates 0, 10, 20, 30 Thous. Tons Per Day
Geographic
Technologic
Mine Worker Access
East River
Ohio Creek
Individual Vehicle
Car Pool
Mass Transit
Mine
Slate River Site
Coal Creek Site
Panel Caving
Room and Pillar
Ore Transport
East River
Ohio Creek
Splains Gulch
Conveyor
Rail
Mill / Tailings
Chance Gulch
Alkali Creek
Carbon Creek
Common Tailings Dam
Earthfill Dam
Mill Worker Access
HY 50
East River
Ohio Creek
Individual Vehicle
Car Pool
Mass Transit
Power Supply
Two Transmission lines from Independent Power Sources
One Transmission line with Emergency onsite power generation
Two Transmission lines from the same Power Source
AMAX Proposal
GCEA Proposal
Other Locations
Entirely Overhead
Combinations Overhead and Underground
Final Project Configuration

Mt. Emmons Mining Project

ALTERNATIVE DESIGN

July 1981

FIG. 2-1

Two sets of mitigation measures were developed. One was put together by AMAX and is reproduced in Appendix A. The other is in Appendix B and is based on mitigation measures identified by the Forest Service, BMML (1981a-d), and AMAX (1981a). One of these sets is applied to each of the seven alternatives described in the following Section, as specified in the description of each alternative.

DESCRIPTIONS OF ALTERNATIVES

PAGE REFERENCE

Alternative 1 11
Alternative 2 12
Alternative 3 18
Alternative 4 20
Alternative 5 22
Alternative 6 24
Alternative 7 26

The Forest Service analyzed seven major alternatives. These are summarized in Table 2-1 and described in detail in the following pages of this Section.

Map 1 in the back pocket of this draft EIS shows the location of the alternative components discussed in this Section. Routes associated with AMAX's proposal are shown with comparative precision while the others appear as corridors. This is because a fair amount of design work has already been completed by AMAX on its proposal. It is unlikely that major changes will be made if those routes are used due to the limitations imposed by grade, topography, and geology. Where less design work has been done and corridors are shown, final locations cannot be predicted as accurately. This is particularly true where private lands are involved. 'Typical' locations are shown in these corridors for comparative purposes.

ALTERNATIVE 1

This is the No Action alternative. It assumes that the Mt. Emmons Project is not developed.

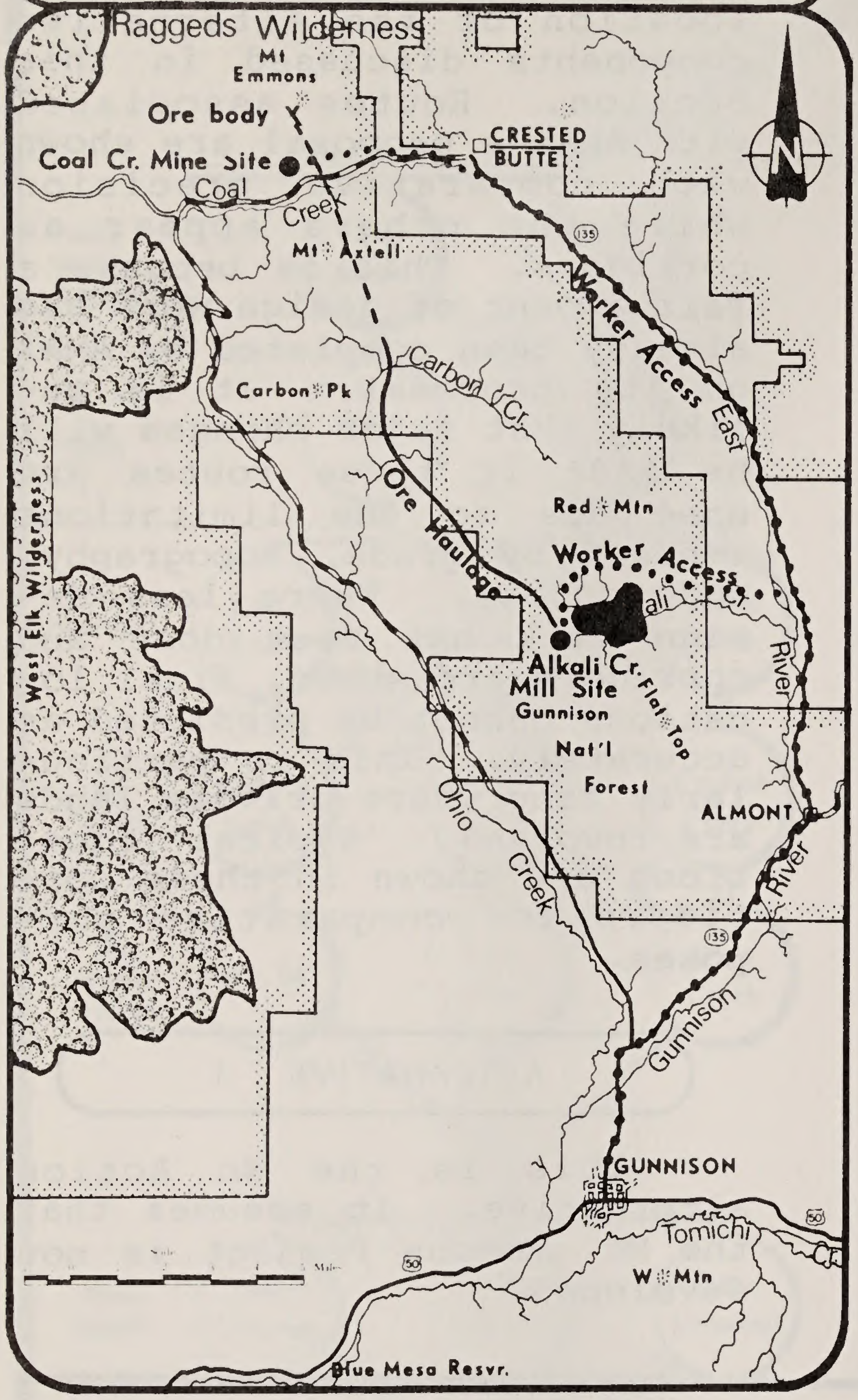
TABLE 2-1. PROJECT ALTERNATIVES

ALTERNATIVE	MINE LOCATION	MILL LOCATION	ORE HAULAGE ROUTE	WORKER ACCESS ROUTE	TONS OF ORE PER DAY	POWER TRANSMISSION: VOLTAGE & CONSTRUCTION METHOD			LAND EXCHANGE	MITIGATION MEASURE(3)
						PAONIA TAP TO MINE	MINE TO GUNNISON	GUNNISON TO SOUTH TAP		
1 No Mine	---	--	---	---	0	---	--	--	NA	---
2 AMAX(1)	Coal Cr.	Alkali	Carbon	Colo. 135	20,000	115 kV OH	115 kV OH	230 kV OH	Proceed(4)	A
3 FS(2)	Coal Cr.	Alkali	Carbon	Colo. 135	20,000	115 kV OH	115 kV OH	230 kV OH	Proceed(5)	B
4	Slate R.	Alkali	East R.	Colo. 135	20,000	115 kV OH	115 kV OH	230 kV OH	NA	B
5	Coal Cr.	Carbon	Splains	Colo. 135	20,000	230 kV OH	115 kV OH	230 kV OH	NA	B
6	Coal Cr.	Carbon	Splains	Colo. 135	10,000	230 kV C	115 kV OH	230 kV OH	NA	B
7	Coal Cr.	Chance Gulch	Ohio Cr.	Colo. 135 & US 50	30,000	115 kV OH	115 kV OH	115 kV OH	NA	B

(1) This is AMAX's proposal.
(2) This is the Forest Service Preferred Alternative.
(3) Column entries refer to mitigation source:
A = measures proposed by AMAX
B = measures identified by the Forest Service, BMML, and AMAX
(4) AMAX's proposal is analyzed without modifications.
(5) AMAX's proposal is analyzed with modifications.

NA = Not Applicable: The land exchange proposal applies only to Alternatives 2 and 3.
OH = Overhead construction
C = Combination overhead and underground construction

ALTERNATIVE 2


Raggeds Wilderness
Mt Emmons
Ore body
Coal Cr. Mine Site
Coal Creek
Mt Axtell
CRESTED BUTTE
N
135
Worker Access
East River
Carbon Pk
Carbon Cr.
Ore Haulage
Red Mtn
Worker Access
Alkali Cr.
Alkali Cr. Mill Site
Gunnison Nat'l Forest
Flat Top
West Elk Wilderness
ALMONT
Ohio Creek
River
Gunnison
GUNNISON
Tomichi Cr
50
W Mtn
Blue Mesa Resvr.

This Alternative is a combination of AMAX's and GCEA's proposals. As shown above, it involves a Coal Creek mine site and an Alkali Creek mill site. Tailing is impounded behind an impermeable earth-fill dam. Appendix C contains technical details on the mine, mill, tailing disposal area, and ore haulage system.

Ore is hauled by a single track electric rail system along the Carbon Creek route. The route exits from Mt. Emmons down-valley from the mine site, crosses Coal Creek, passes through a 4-mile tunnel under Mt. Axtell, and traverses across the west flank of Red Mountain to the mill. A second 0.7-mile tunnel occurs along this route. Waste rock taken out of the ore haulage tunnel in Mt. Emmons is placed as fill along Coal Creek at the crossing.

Approximately 155 million tons of ore are mined at a production rate of 20,000 tons per day. A panel caving method is used, and the project life is about 30 years.

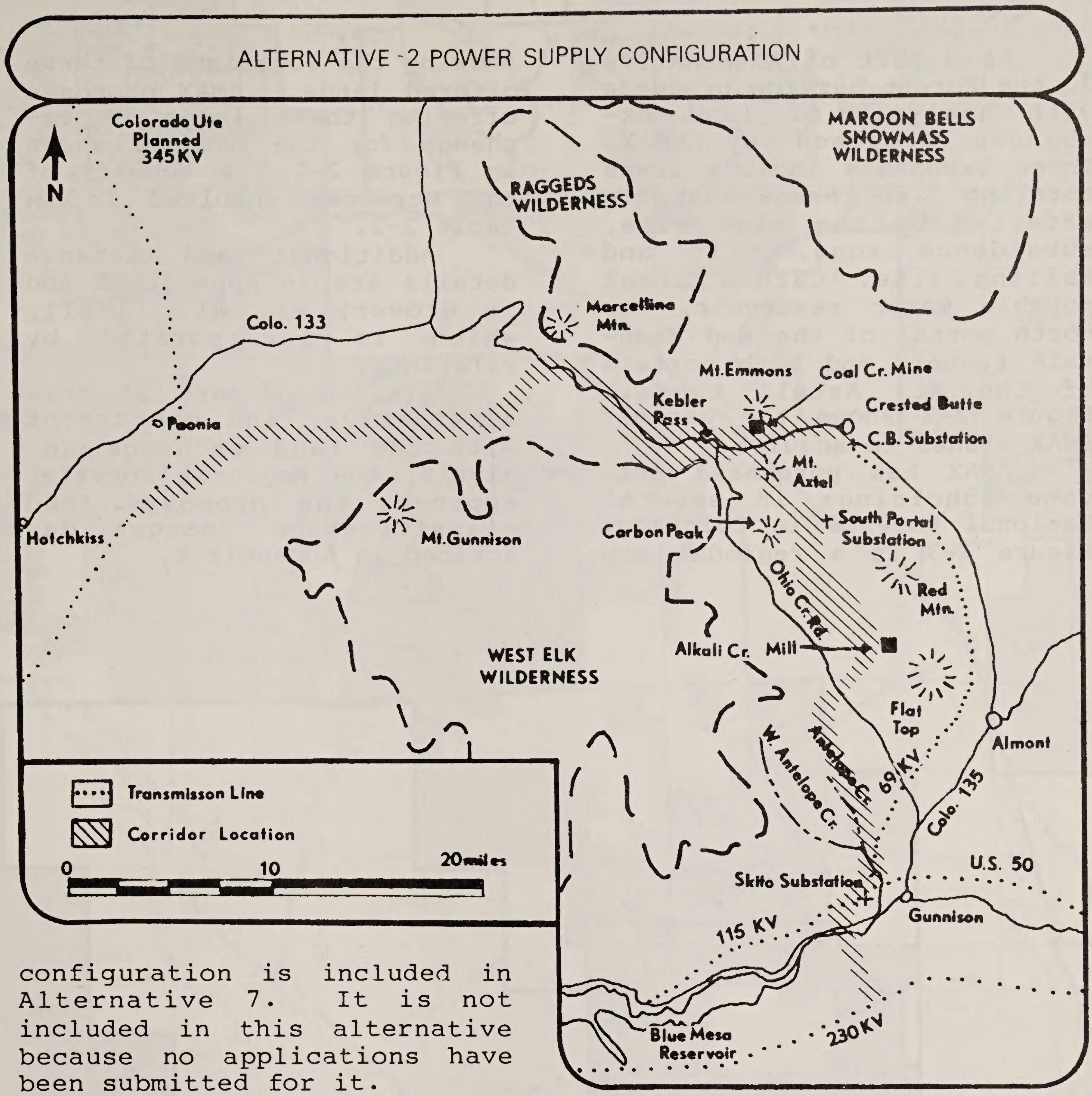
Worker access is via Colorado 135 along the East River valley with a bypass around the south side of the Town of Crested Butte for mine access.

Water for the mill is pumped from the East River to a 2,000 acre-foot storage reservoir located below the tailing dam.

Potable water is stored in a 500 acre-foot reservoir located on Carbon Creek one-half mile east of the Mt. Axtell tunnel's south portal. If additional water is needed, a second reservoir will be placed on Elk Creek immediately west of the mine site. It will be filled with water from Elk Creek and the Slate River.

Additional details are in AMAX (1979a, 1980a, and 1981a Chapter 9), which are incorporated by reference.

GCEA's proposed configuration is shown on the opposite page. It is designed to serve Alternative 2, but can also serve Alternatives 3-6. AMAX identified a configuration different from the one shown above, but GCEA chose not to adopt it. AMAX's


ALTERNATIVE-2 POWER SUPPLY CONFIGURATION
Colorado Ute Planned 345KV
N
MAROON BELLS SNOWMASS WILDERNESS
RAGGEDS WILDERNESS
Marcellina Mtn.
Colo. 133
Mt.Emmons
Coal Cr. Mine
Kebler Pass
Crested Butte
C.B. Substation
Paonia
Mt. Axtel
Hotchkiss
Mt.Gunnison
Carbon Peak
South Portal Substation
Ohio Cr. Rd.
Red Mtn.
Alkali Cr. Mill
WEST ELK WILDERNESS
Flat Top
Almont
Antelope Cr.
W. Antelope Cr.
69 KV
Colo. 135
Transmisson Line
Corridor Location
0
10
20 miles
U.S. 50
Skito Substation
Gunnison
115 KV
Blue Mesa Reservoir
230 KV

configuration is included in Alternative 7. It is not included in this alternative because no applications have been submitted for it.

This configuration involves an overhead system with a normal transmission capacity of 115 kV, except for a short section at the south end which is a double circuit 230 kV line serving the Skito substation on the west side of Gunnison.

The corridor follows Antelope Creek north from the Skito substation, enters the Ohio Creek valley, and climbs to the Alkali Creek mill site. From there it follows the west slopes of Red Mountain to the east side of Carbon Peak and crosses the west flank of Mt. Axtell to connect with the Coal Creek mine site. A short spur connects the mine site with the Crested Butte substation.

West of the mine site, the corridor crosses through the Kebler Pass area and continues to the vicinity of Paonia.

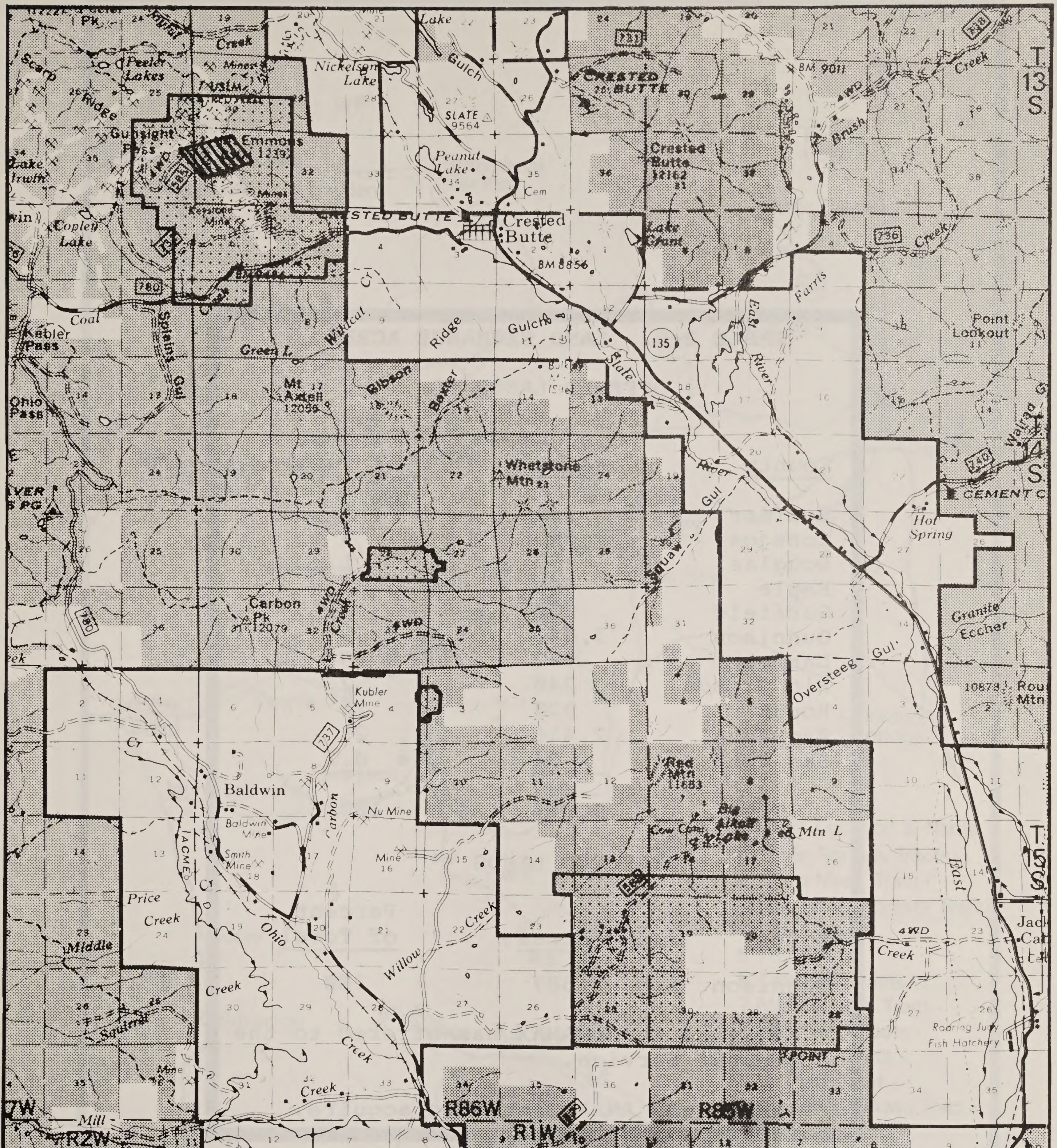
The mitigation measures in Appendix A apply to this Alternative.

As a part of Alternative 2, the Forest Service proceeds with analysis of land exchanges proposed by AMAX. These exchanges include areas totaling 7,587 acres that are affected by the mine site, subsidence zone, mill and tailing site, Carbon Creek potable water reservoir, the north portal of the Red Mountain tunnel, and both portals of the Mt. Axtell tunnel. Figure 2-2 shows the parcels AMAX wishes to acquire.

AMAX has purchased private inholdings in several National Forests in Colorado. Figure 2-3 is a regional map showing the locations of these offered lands. AMAX proposes offering these lands in exchange for the parcels shown in Figure 2-2. A summary of the acreages involved is in Table 2-2.

Additional land exchange details are in Appendix F and in Glover, et. al. (1981), which is incorporated by reference.

Also as a part of this alternative, and concurrent with the land exchange analysis, the Regional Forester approves the proposed land classification changes described in Appendix E.


Peeler Lakes
Scarp Ridge
Gunsight Pass
Emmons 12392
Lake Irwin
Copley Lake
Keystone Mine
Kebler Pass
Ohio Pass
Nickelson Lake
Slate 9564
Peanut Lake
Crested Butte
BM 8856
Crested Butte 12162
Lake Grant
BM 9011
Brush Creek
Point Lookout
Wildcat Cr
Ridge
Gulch
Slate
Mt Axtell 12055
Gibson
Baxter
Whetstone Mtn
East River
Farris
Hot Spring
Cement C
Carbon Pk 12079
Squaw Gul
Oversteeg Gul
Granite
Eccher
Round Mtn 10878
Kubler Mine
Baldwin
Baldwin Mine
Smith Mine
Nu Mine
Carbon
Red Mtn 11683
Big Alkali Lake
Mtn L
Price Creek
Ohio Creek
Willow Creek
Middle
Squirrel
Mill Creek
Roaring Judy Fish Hatchery
Jack Cab
R86W
R85W
R1W
R2W
Top Point
River
T 13 S
T 14 S
T 15 S
0 2 4 miles

LEGEND

▨ LANDS AMAX PROPOSES TO ACQUIRE BY MINERAL PATENT.

⬚ LANDS AMAX PROPOSES TO ACQUIRE BY LAND EXCHANGE.

▓ NATIONAL FOREST LAND.

Mt. Emmons Mining Project

LANDS AMAX PROPOSES TO ACQUIRE

July 1981

FIG. 2-2

TABLE 2-2. LAND EXCHANGE ACRES

OFFERED LANDS *

County	Acres	Percent of Total
Boulder	142	1
Conejos	595	6
Douglas	70	1
Eagle	160	2
Garfield	800	8
Gunnison	3,441	35
Larimer	999	10
Rio Grande	240	2
Routt	920	10
Saguache	2,416	25
San Juan	24	0.2
TOTAL	9,807	100.2

SELECTED LANDS **

County	Acres	Percent of Total
Gunnison	7,587	100

* Private lands AMAX has offered to the Forest Service.

** NFS lands AMAX wishes to acquire.

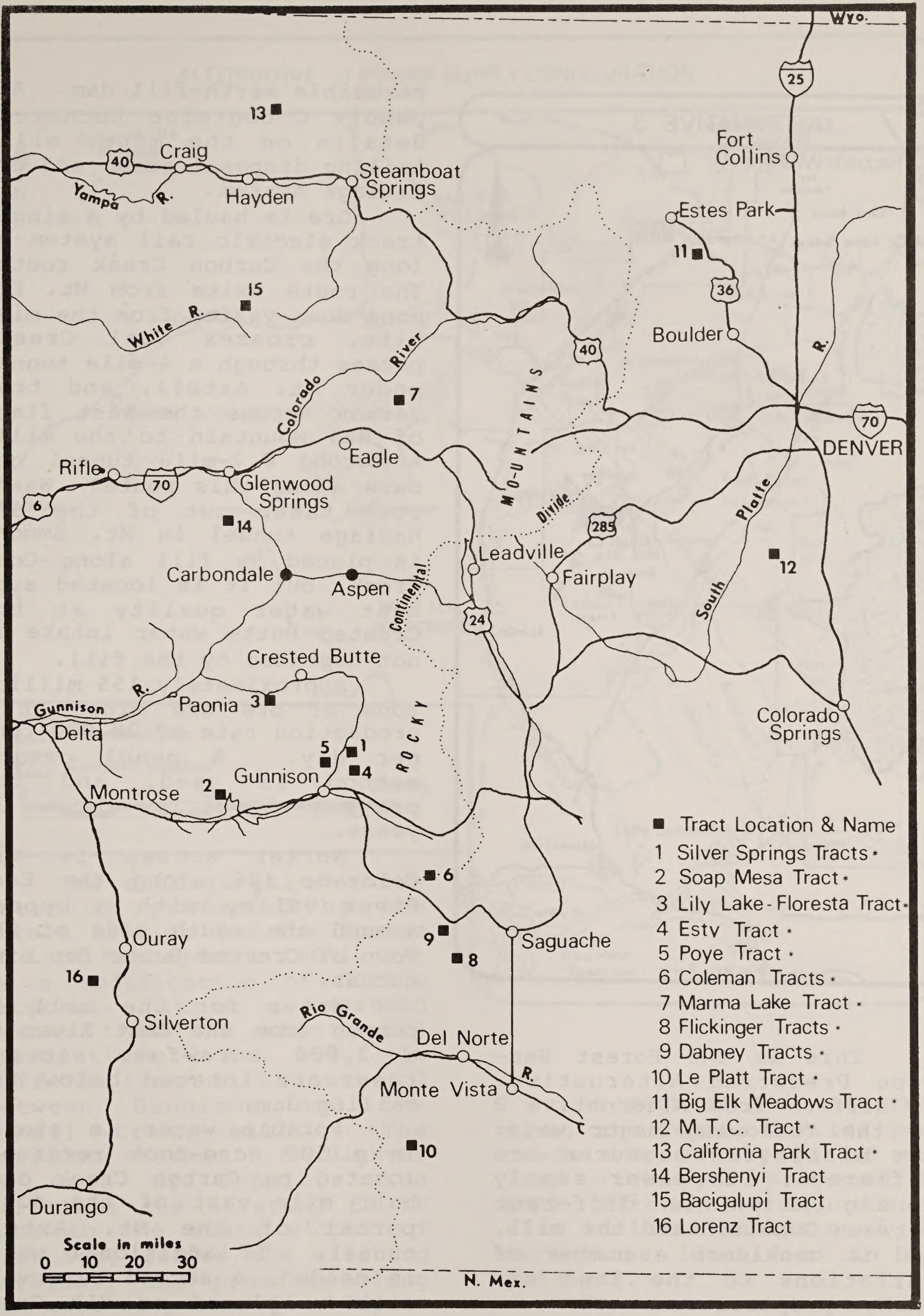
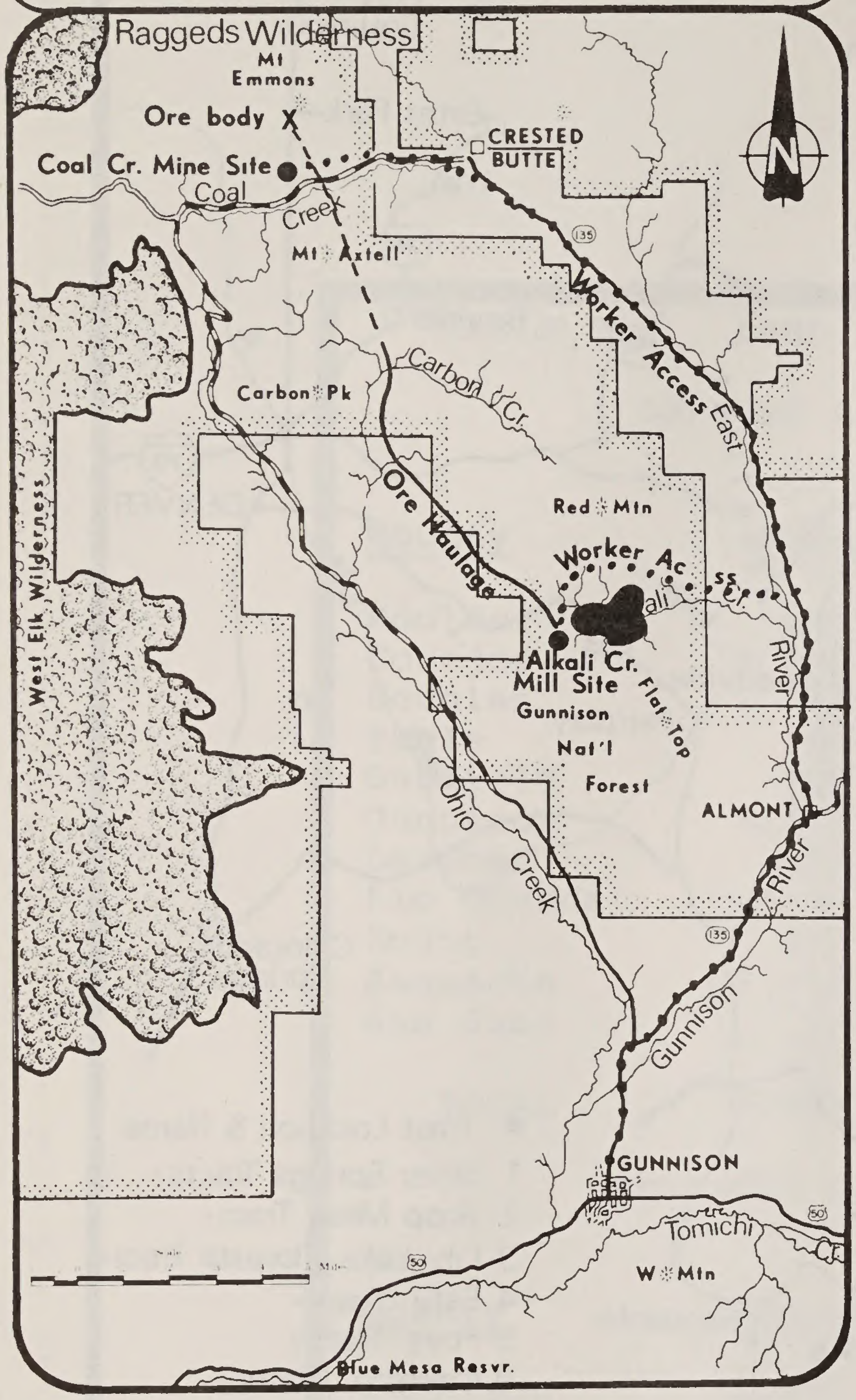

Wyo.
25
13
40
Craig
Yampa R.
Hayden
Steamboat Springs
Fort Collins
Estes Park
11
36
15
White R.
Boulder
R.
40
Colorado River
7
MOUNTAINS
70
DENVER
Eagle
Rifle
6
70
Glenwood Springs
14
Divide
285
South Platte
Leadville
12
Carbondale
Aspen
Fairplay
Continental
24
Crested Butte
Gunnison R.
Paonia
3
Delta
Colorado Springs
ROCKY
5
1
4
Gunnison
2
Montrose
■ Tract Location & Name
1 Silver Springs Tracts *
2 Soap Mesa Tract *
3 Lily Lake-Floresta Tract *
4 Esty Tract *
5 Poye Tract *
6 Coleman Tracts *
7 Marma Lake Tract *
8 Flickinger Tracts *
9 Dabney Tracts *
10 Le Platt Tract *
11 Big Elk Meadows Tract *
12 M. T. C. Tract *
13 California Park Tract *
14 Bershenyi Tract
15 Bacigalupi Tract
16 Lorenz Tract
6
9
8
Saguache
Ouray
16
Silverton
Rio Grande
Del Norte
R.
Monte Vista
10
Durango
Scale in miles
0 10 20 30
N. Mex.

Figure: 2-3 LANDS AMAX PROPOSES TO OFFER TO THE FOREST SERVICE

* Described in AMAX offered Land Reports (Glover, et. al., 1981)

ALTERNATIVE 3


Raggeds Wilderness
Mt Emmons
Ore body
Coal Cr. Mine Site
Coal
Creek
CRESTED BUTTE
N
135
Mt Axtell
Worker Access East
Carbon Cr.
Carbon Pk
Ore Haulage
Red Mtn
Worker Access
Alkali Cr.
Alkali Cr. Mill Site
Flat Top
River
Gunnison Nat'l Forest
West Elk Wilderness
ALMONT
Ohio Creek
River
135
Gunnison
GUNNISON
50
Tomichi Cr
W Mtn
Blue Mesa Resvr.

This is the Forest Service Preferred Alternative. It differs from Alternative 2 in the following major ways: its mitigation measures are different, its power supply configuration is different between Gunnison and the mill, and it considers a number of variations to the land exchange proposal.

This Alternative involves a Coal Creek mine site and an Alkali Creek mill site. Tailing is impounded behind an impermeable earth-fill dam. Appendix C contains technical details on the mine, mill, tailing disposal area, and ore haulage system.

Ore is hauled by a single track electric rail system along the Carbon Creek route. The route exits from Mt. Emmons down-valley from the mine site, crosses Coal Creek, passes through a 4-mile tunnel under Mt. Axtell, and traverses across the west flank of Red Mountain to the mill. A second 0.7-mile tunnel occurs along this route. Waste rock taken out of the ore haulage tunnel in Mt. Emmons is placed as fill along Coal Creek, but it is located such that water quality at the Crested Butte water intake is not degraded by the fill.

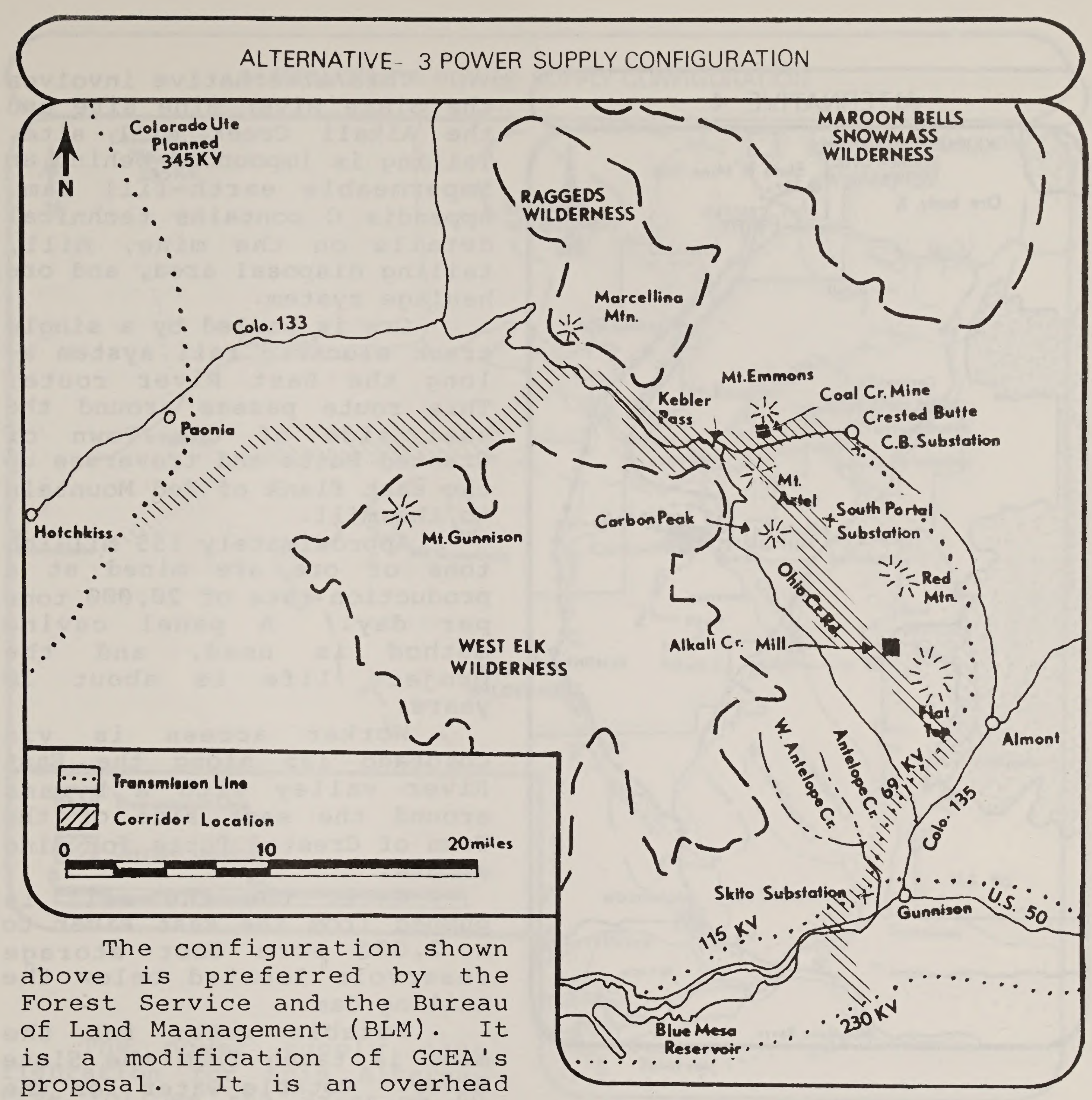
Approximately 155 million tons of ore are mined at a production rate of 20,000 tons per day. A panel caving method is used, and the project life is about 30 years.

Worker access is via Colorado 135 along the East River valley with a bypass around the south side of the Town of Crested Butte for mine access.

Water for the mill is pumped from the East River to a 2,000 acre-foot storage reservoir located below the tailing dam.

Potable water is stored in a 500 acre-foot reservoir located on Carbon Creek one-half mile east of the south portal of the Mt. Axtell tunnel. If additional water is needed, a second reservoir will be placed on Elk Creek immediately west of the mine site. It will be filled with water from Elk Creek and the Slate River.

ALTERNATIVE- 3 POWER SUPPLY CONFIGURATION

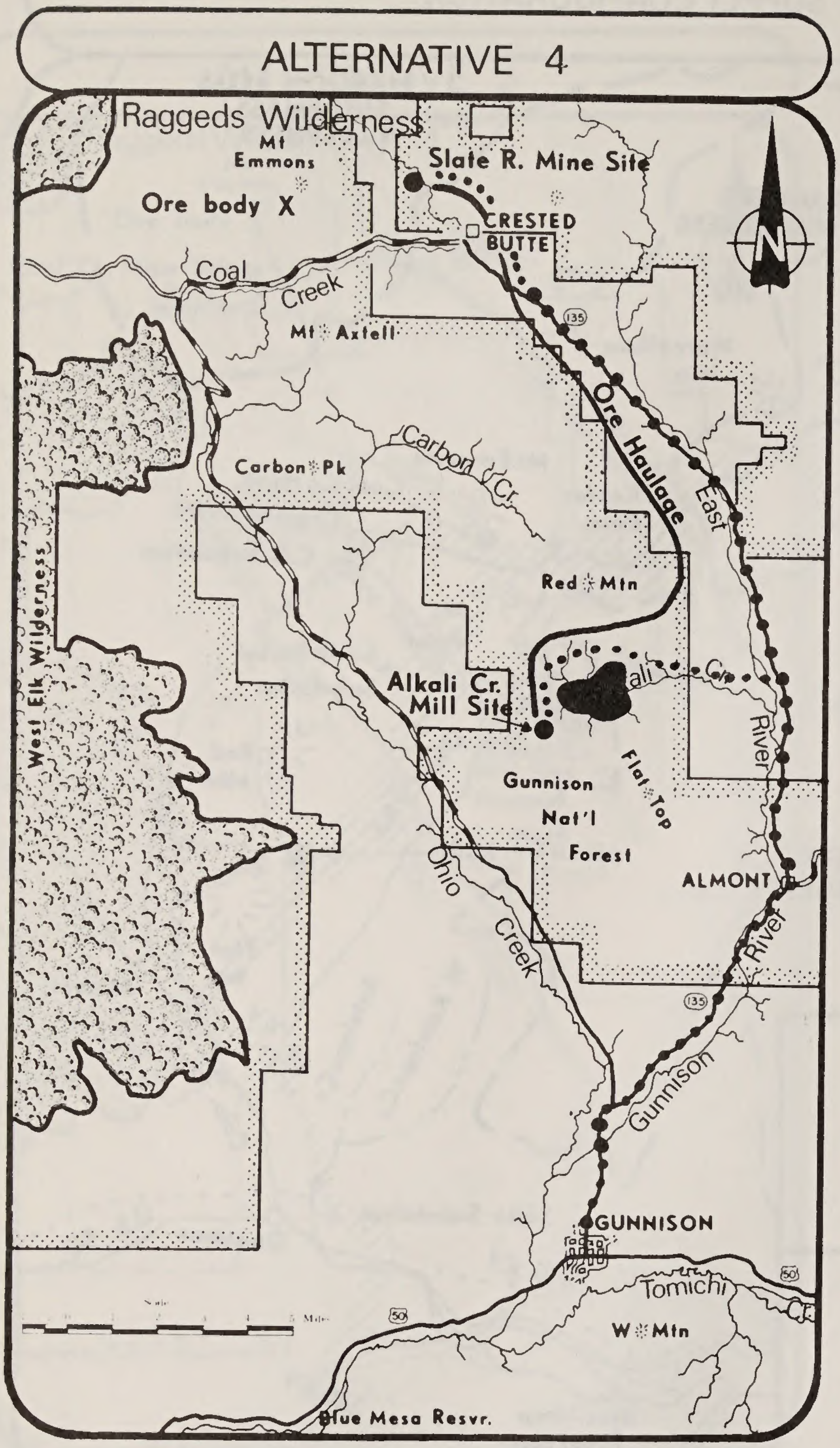

Colorado Ute Planned 345KV
N
RAGGEDS WILDERNESS
MAROON BELLS SNOWMASS WILDERNESS
Marcellina Mtn.
Colo. 133
Mt.Emmons
Kebler Pass
Coal Cr. Mine
Crested Butte
C.B. Substation
Paonia
Mt. Axtel
South Portal Substation
Carbon Peak
Hotchkiss
Mt.Gunnison
Red Mtn.
Ohio Cr. Rd.
Alkali Cr. Mill
WEST ELK WILDERNESS
Flat Top
Almont
W. Antelope Cr.
Antelope Cr.
69 KV
Colo. 135
Transmisson Line
Corridor Location
0
10
20miles
Skito Substation
Gunnison
U.S. 50
115 KV
230 KV
Blue Mesa Reservoir

The configuration shown above is preferred by the Forest Service and the Bureau of Land Maanagement (BLM). It is a modification of GCEA's proposal. It is an overhead system that can also serve Alternatives 2 and 4-6. It differs from Alternative 2 between Gunnison and the Alkali Creek mill. The corridor crosses U.S. Highway 50 west of Gunnison and parallels the existing 69 kV line to the south slopes of Flat Top, leaves the existing corridor, and proceeds along the west slopes of Flat Top to the mill.

The mitigation measures in Appendix B apply to this alternative.

As part of this alternative, the Forest Service proceeds with analysis of the land exchanges proposed by AMAX (Alternative 2), but it also includes analysis of the variations identified in Appendix F.

Concurrent with land exchange analysis, the Regional Forester approves the proposed land classification changes described in Appendix E.


ALTERNATIVE 4
Raggeds Wilderness
Mt Emmons
Ore body X
Slate R. Mine Site
CRESTED BUTTE
N
Coal
Creek
Mt Axtell
135
Ore Haulage
East
Carbon Pk
Carbon Cr.
Red Mtn
Alkali Cr. Mill Site
Alkali Cr.
River
West Elk Wilderness
Gunnison Nat'l Forest
Flat Top
ALMONT
Ohio
Creek
River
135
Gunnison
GUNNISON
50
Tomichi
Cr
50
W Mtn
Blue Mesa Resvr.

This alternative involves the Slate River mine site and the Alkali Creek mill site. Tailing is impounded behind an impermeable earth-fill dam. Appendix C contains technical details on the mine, mill, tailing disposal area, and ore haulage system.

Ore is hauled by a single track electric rail system along the East River route. This route passes around the east side of the Town of Crested Butte and traverses up the east flank of Red Mountain to the mill.

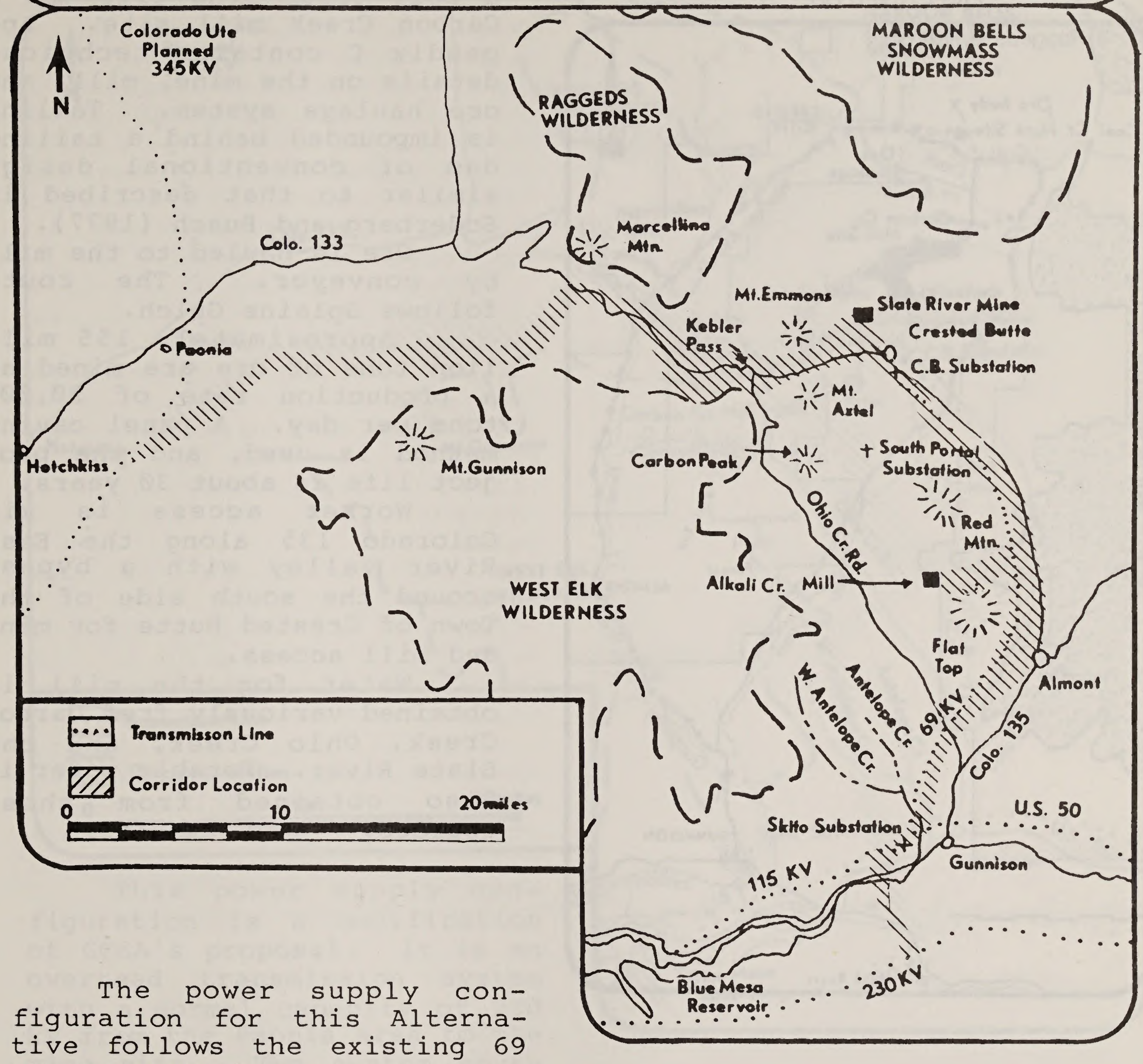
Approximately 155 million tons of ore are mined at a production rate of 20,000 tons per day. A panel caving method is used, and the project life is about 30 years.

Worker access is via Colorado 135 along the East River valley with a bypass around the east side of the Town of Crested Butte for mine access.

Water for the mill is pumped from the East River to a 2,000 acre foot storage reservoir located below the tailing dam.

Potable water for the mine is taken from the Slate River. Potable water for the mill is taken from the East River.

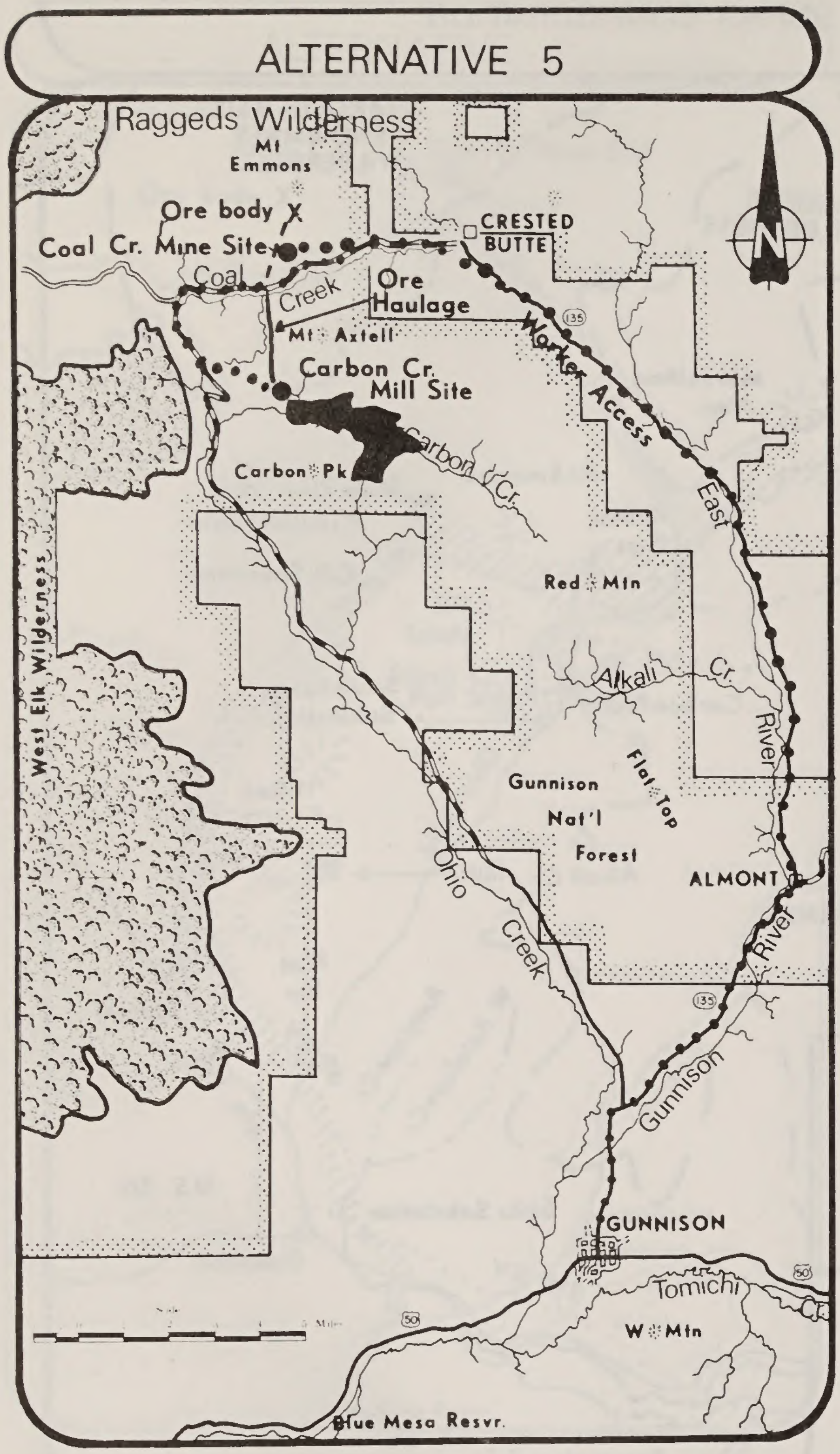
ALTERNATIVE-4 POWER SUPPLY CONFIGURATION


Colorado Ute
Planned
345KV
N
RAGGEDS WILDERNESS
MAROON BELLS SNOWMASS WILDERNESS
Marcellina Mtn.
Colo. 133
Mt.Emmons
Slate River Mine
Crested Butte
Kebler Pass
C.B. Substation
Paonia
Mt. Axtel
Hotchkiss
Mt.Gunnison
Carbon Peak
South Portal Substation
Ohio Cr. Rd.
Red Mtn.
WEST ELK WILDERNESS
Alkali Cr.
Mill
Flat Top
Almont
W. Antelope Cr.
Antelope Cr.
69 KV
Colo. 135
Transmisson Line
Corridor Location
0
10
20 miles
U.S. 50
Skito Substation
Gunnison
115 KV
230 KV
Blue Mesa Reservoir

The power supply configuration for this Alternative follows the existing 69 kV transmission line between Gunnison and the Crested Butte area. It is an overhead system serving only Alternative 4. The corridor crosses U.S. Highway 50 just west of Gunnison and then follows the existing line into the East River valley and on to the Crested Butte substation. A short double circuit spur connects with the Alkali Creek mill site, and a single circuit goes north to the Slate River mine site. The main corridor goes west of Kebler Pass to the Paonia area.

The mitigation measures in Appendix B apply to this alternative.

No land exchange proposal specific to this alternative has been identified, but it is possible that one would be submitted if the alternative were to be implemented.


ALTERNATIVE 5

Raggeds Wilderness
Mt Emmons
Ore body
Coal Cr. Mine Site
Coal Creek
Ore Haulage
CRESTED BUTTE
Mt Axtell
Carbon Cr. Mill Site
Carbon Pk
Carbon Cr.
Worker Access
135
East River
Red Mtn
Alkali Cr.
West Elk Wilderness
Gunnison Nat'l Forest
Flat Top
Ohio Creek
ALMONT
Gunnison
GUNNISON
Tomichi
50
W Mtn
Blue Mesa Resvr.
N

This alternative involves a Coal Creek mine site and a Carbon Creek mill site. Appendix C contains technical details on the mine, mill, and ore haulage system. Tailing is impounded behind a tailing dam of conventional design similar to that described in Soderberg and Busch (1977).

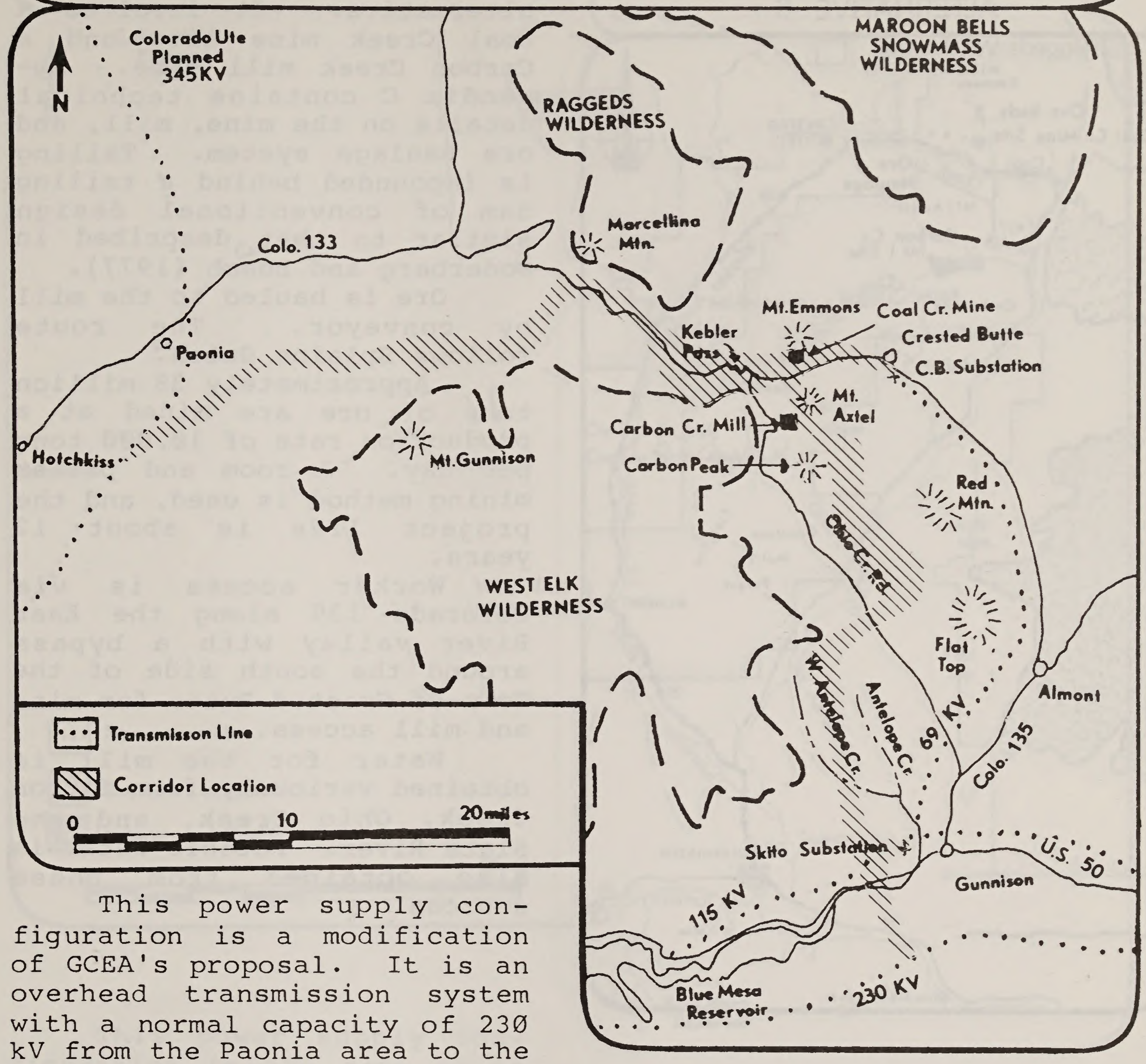
Ore is hauled to the mill by conveyor. The route follows Splains Gulch.

Approximately 155 million tons of ore are mined at a production rate of 20,000 tons per day. A panel caving method is used, and the project life is about 30 years.

Worker access is via Colorado 135 along the East River valley with a bypass around the south side of the Town of Crested Butte for mine and mill access.

Water for the mill is obtained variously from Carbon Creek, Ohio Creek, and the Slate River. Potable water is also obtained from these sources.

ALTERNATIVE-5 POWER SUPPLY CONFIGURATION

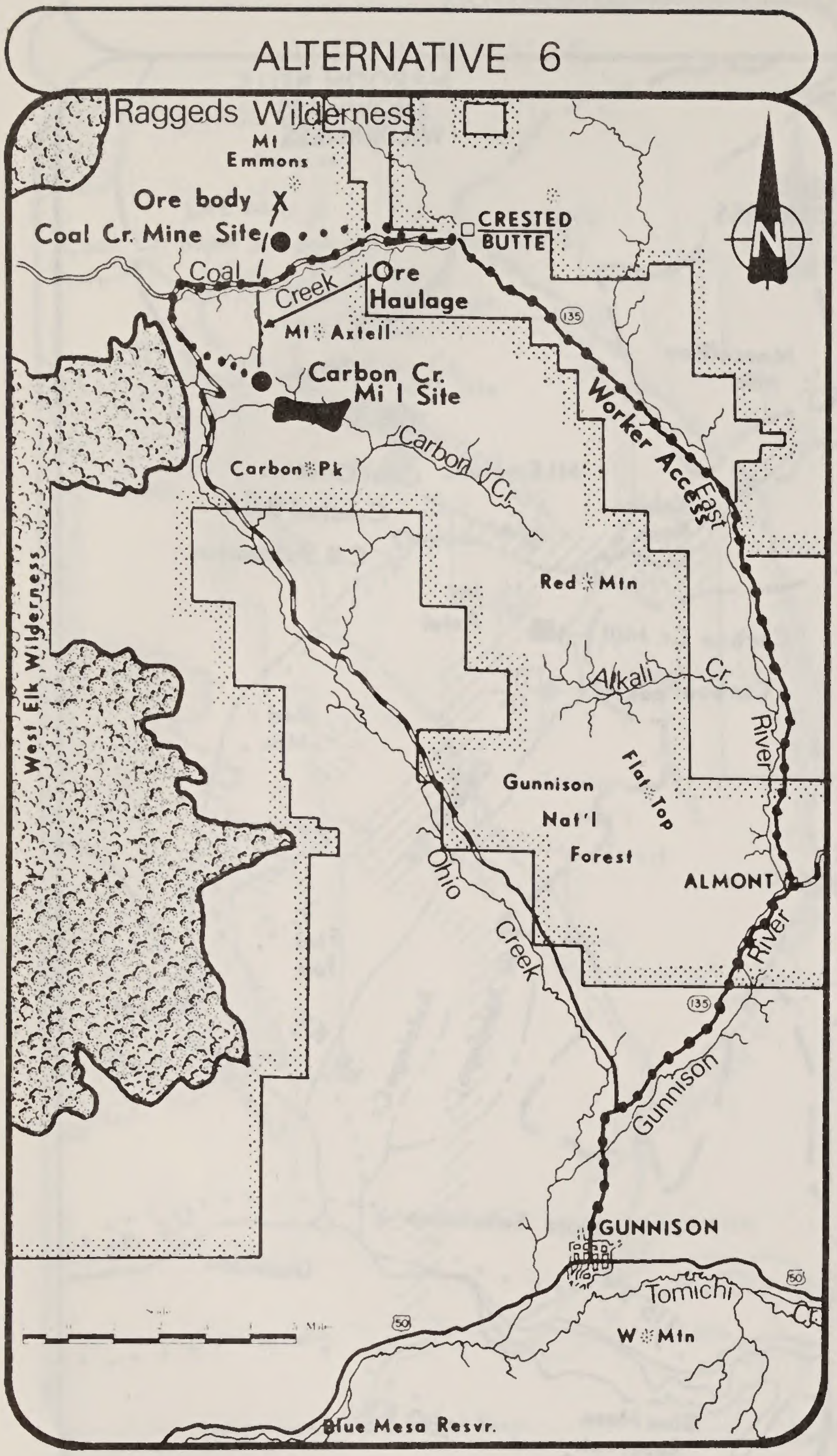

Colorado Ute Planned 345KV
N
RAGGEDS WILDERNESS
MAROON BELLS SNOWMASS WILDERNESS
Marcellina Mtn.
Colo. 133
Paonia
Hotchkiss
Mt.Emmons
Coal Cr. Mine
Crested Butte
C.B. Substation
Kebler Pass
Mt. Axtel
Carbon Cr. Mill
Carbon Peak
Mt.Gunnison
Red Mtn.
Ohio Cr. Rd.
WEST ELK WILDERNESS
Flat Top
Almont
W. Antelope Cr.
Antelope Cr.
69 KV
Colo. 135
Transmisson Line
Corridor Location
0
10
20 miles
Skito Substation
U.S. 50
Gunnison
115 KV
Blue Mesa Reservoir
230 KV

This power supply configuration is a modification of GCEA's proposal. It is an overhead transmission system with a normal capacity of 230 kV from the Paonia area to the mine site. The system south to Gunnison has a capacity of 115 kV, with the exception of a short double circuit 230 kV line at the extreme southern end.

The corridor begins southwest of Gunnison and crosses U.S. Highway 50 just west of the city. It turns east a short distance to connect with the Skito substation and then doubles back to turn northward between Antelope Creek and West Antelope Creek. It then proceeds in a northerly direction to the Carbon Creek mill site.

The mitigation measures in Appendix B apply to this alternative.

No land exchange proposal specific to this Alternative has been identified, but it is possible that one would be submitted if the Alternative were to be implemented.


ALTERNATIVE 6
Raggeds Wilderness
Mt Emmons
Ore body
Coal Cr. Mine Site
CRESTED BUTTE
Coal Creek
Ore Haulage
Mt Axtell
Carbon Cr. Mill Site
Carbon Pk
Carbon Cr.
Worker Access
East
135
N
Red Mtn
Alkali Cr.
River
West Elk Wilderness
Gunnison Nat'l Forest
Flat Top
ALMONT
Ohio Creek
River
135
Gunnison
GUNNISON
Tomichi
50
50
W Mtn
Miles
Blue Mesa Resvr.

This is the "Small Mine" alternative. It involves a Coal Creek mine site and a Carbon Creek mill site. Appendix C contains technical details on the mine, mill, and ore haulage system. Tailing is impounded behind a tailing dam of conventional design similar to that described in Soderberg and Busch (1977).

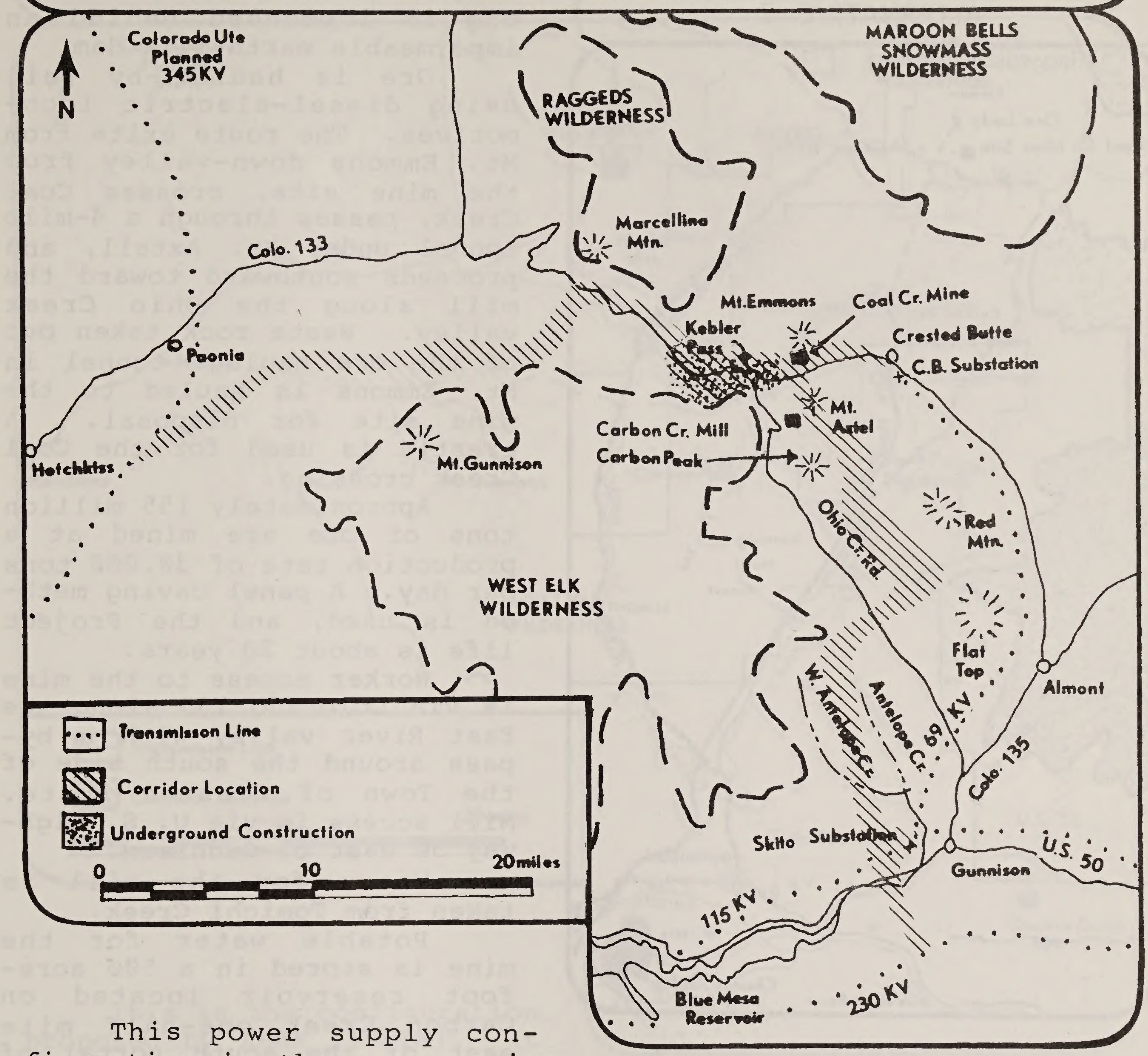
Ore is hauled to the mill by conveyor. The route follows Splains Gulch.

Approximately 38 million tons of ore are mined at a production rate of 10,000 tons per day. A room and pillar mining method is used, and the project life is about 12 years.

Worker access is via Colorado 135 along the East River valley with a bypass around the south side of the Town of Crested Butte for mine and mill access.

Water for the mill is obtained variously from Carbon Creek, Ohio Creek, and the Slate River. Potable water is also obtained from these sources.

ALTERNATIVE-6 POWER SUPPLY CONFIGURATION


N
Colorado Ute Planned 345KV
RAGGEDS WILDERNESS
MAROON BELLS SNOWMASS WILDERNESS
Marcellina Mtn.
Colo. 133
Paonia
Hotchkiss
Mt. Emmons
Coal Cr. Mine
Kebler Pass
Crested Butte
C.B. Substation
Mt. Axtel
Carbon Cr. Mill
Carbon Peak
Mt. Gunnison
Ohio Cr. Rd.
Red Mtn.
WEST ELK WILDERNESS
Flat Top
Almont
69 KV
W. Antelope Cr.
Antelope Cr.
Colo. 135
Skito Substation
Gunnison
U.S. 50
115 KV
230 KV
Blue Mesa Reservoir
Transmisson Line
Corridor Location
Underground Construction
0
10
20 miles

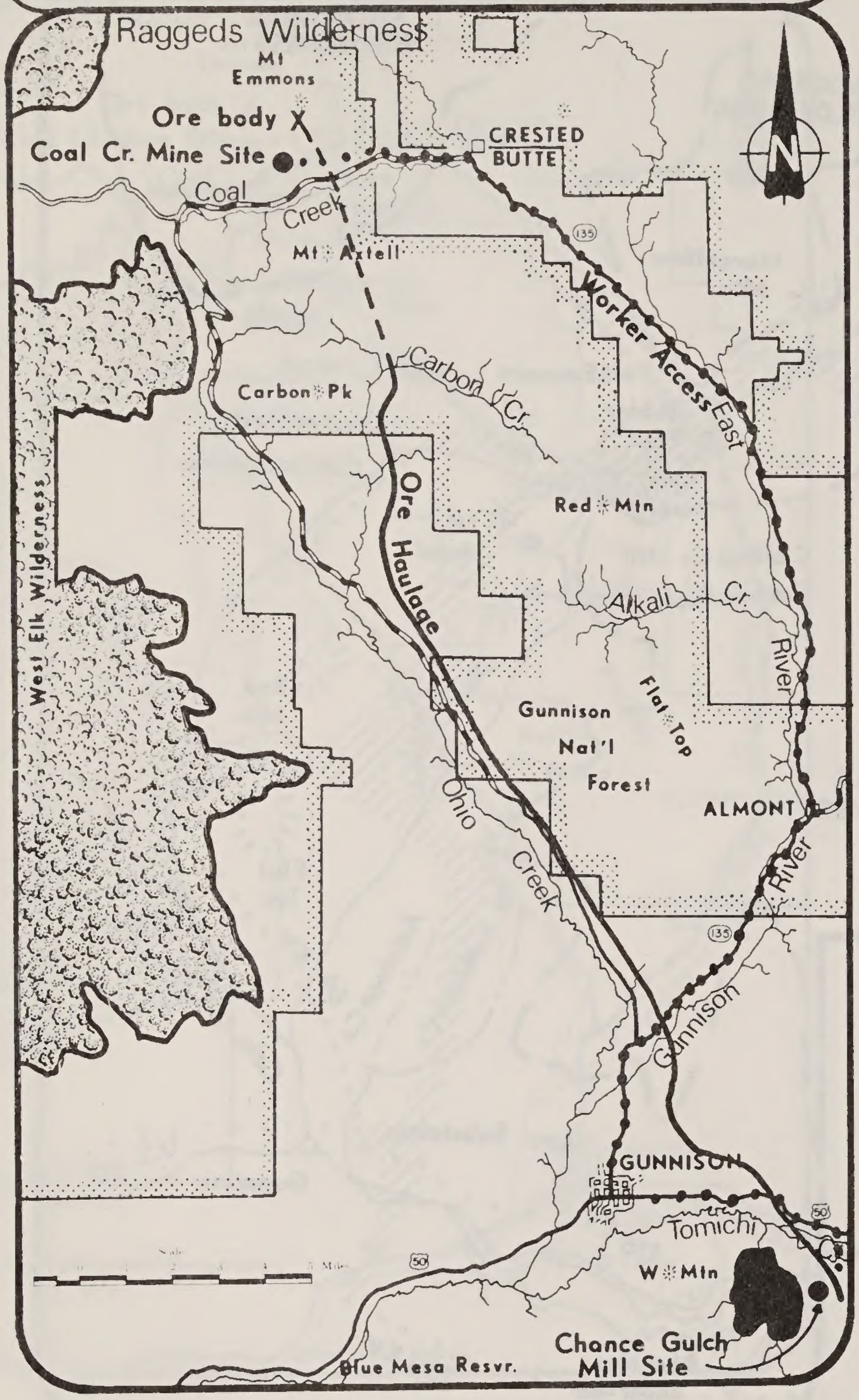
This power supply configuration is the same as in Alternative 5 except that a part of the system is placed underground. Beginning approximately one-half mile east of Kebler Pass and extending to approximately three miles east of Marcellina Mountain, a high pressure, oil-filled electrical transmission pipeline is installed underground.

The system has a normal capacity of 230 kV from the Paonia area to the mine site. The system south to Gunnison has a capacity of 115 kV, with the exception of a short double circuit 230 kV line at the extreme southern end.

The mitigation measures in Appendix B apply to this alternative.

No land exchange proposal specific to this Alternative has been identified, but it is possible that one would be submitted if the Alternative were to be implemented.

ALTERNATIVE 7



Raggeds Wilderness
Mt Emmons
Ore body X
Coal Cr. Mine Site
CRESTED BUTTE
N
Coal Creek
Mt Axtell
135
Worker Access East
Carbon Cr.
Carbon Pk
Ore Haulage
Red Mtn
Alkali Cr.
West Elk Wilderness
Gunnison Nat'l Forest
Flat Top
River
ALMONT
Ohio Creek
River
135
Gunnison
GUNNISON
50
Tomichi
50
W Mtn
Blue Mesa Resvr.
Chance Gulch Mill Site

This alternative involves a Coal Creek mine site and a Chance Gulch mill site. Appendix C contains technical details on the mine, mill, and ore haulage system. The tailing disposal area is lined to prevent seepage, and tailing is impounded behind an impermeable earth-fill dam.

Ore is hauled by rail using diesel-electric locomotives. The route exits from Mt. Emmons down-valley from the mine site, crosses Coal Creek, passes through a 4-mile tunnel under Mt. Axtell, and proceeds southward toward the mill along the Ohio Creek valley. Waste rock taken out of the ore haulage tunnel in Mt. Emmons is hauled to the mine site for disposal. A trestle is used for the Coal Creek crossing.

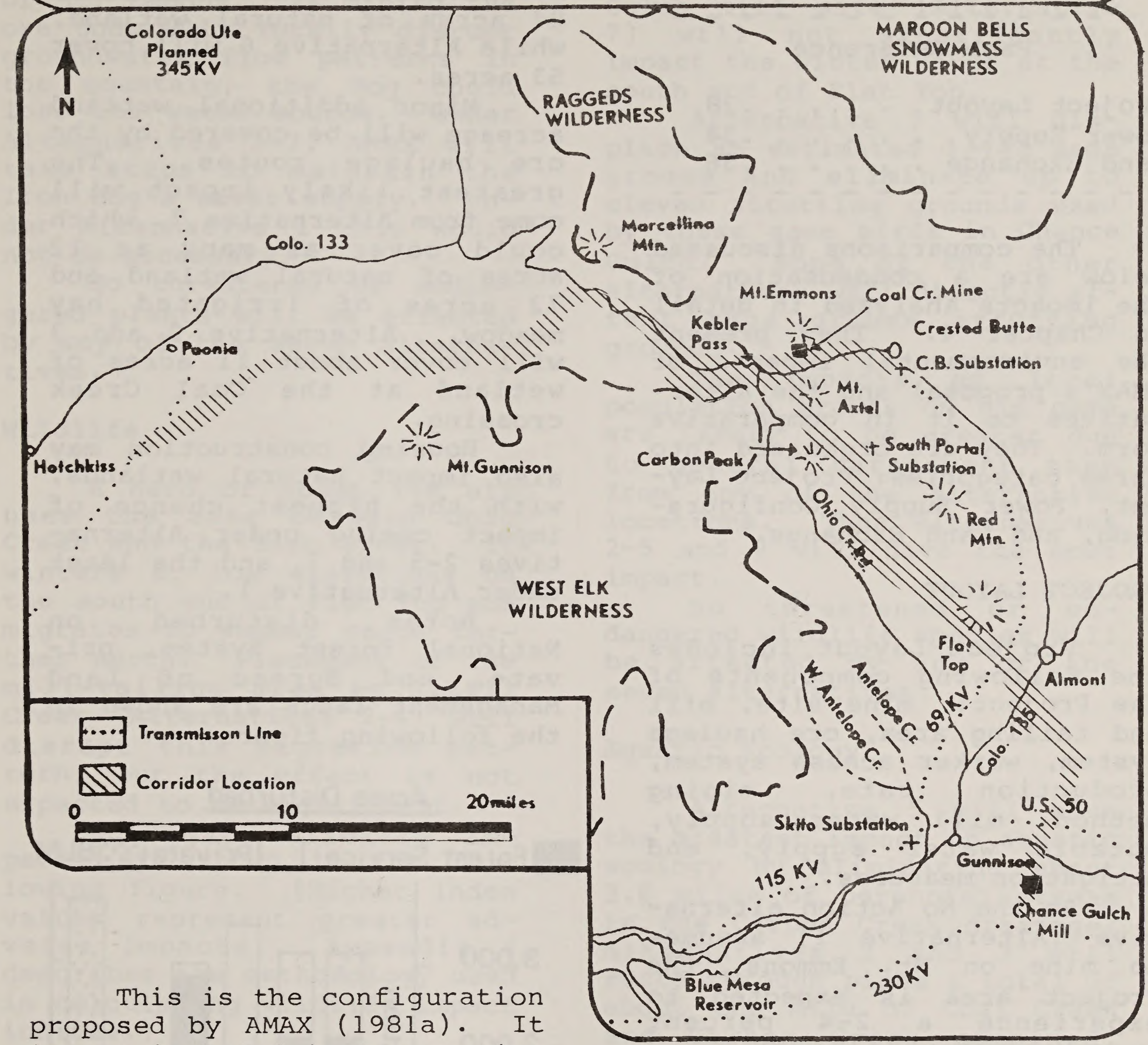
Approximately 155 million tons of ore are mined at a production rate of 30,000 tons per day. A panel caving method is used, and the Project life is about 20 years.

Worker access to the mine is via Colorado 135 along the East River valley with a bypass around the south side of the Town of Crested Butte. Mill access is via U. S. Highway 50 east of Gunnison.

Water for the mill is taken from Tomichi Creek.

Potable water for the mine is stored in a 500 acre-foot reservoir located on Carbon Creek one-half mile east of the south portal of the Mt. Axtell tunnel. If additional water is needed, a second reservoir will be placed on Elk Creek immediately west of the mine site. It will be filled with water from Elk Creek and the Slate River. Potable water for the mill is taken out of Tomichi Creek.

ALTERNATIVE-7 POWER SUPPLY CONFIGURATION


Colorado Ute Planned 345KV
N
RAGGEDS WILDERNESS
MAROON BELLS SNOWMASS WILDERNESS
Marcellina Mtn.
Colo. 133
Mt.Emmons
Coal Cr. Mine
Kebler Pass
Crested Butte
C.B. Substation
Paonia
Mt. Axtel
Hotchkiss
Mt.Gunnison
Carbon Peak
South Portal Substation
Ohio Cr. Rd.
Red Mtn.
WEST ELK WILDERNESS
Flat Top
Almont
W. Antelope Cr.
Antelope Cr.
69 KV
Colo. 135
Transmisson Line
Corridor Location
0
10
20miles
U.S. 50
Skito Substation
Gunnison
115 KV
Chance Gulch Mill
Blue Mesa Reservoir
230 KV

This is the configuration proposed by AMAX (1981a). It is not included in Alternative 2 because no applications have been submitted for it. It is an overhead 115 kV system that begins southeast of Gunnison and passes through the Chance Gulch area. It crosses U.S. Highway 50 east of Gunnison and continues northward, crossing Colorado 135 south of Almont and then passing around the west side of Flat Top to reach the top of Alkali Basin. From there it follows the same route as described in Alternative 2.

The mitigation measures in Appendix B apply to this alternative.

No land exchange proposal specific to this Alternative has been identified, but it is possible that one would be submitted if the Alternative were to be implemented.

COMPARISON OF ALTERNATIVES

- - - - - - - - - - - - - - - - - -

Page Reference

Project Layout 28
Power Supply 34
Land Exchange 36

- - - - - - - - - - - - - - - - - -

The comparisons discussed below are a condensation of the impacts analyzed in detail in Chapter 4. They present the environmental impacts of AMAX's proposal and the alternatives to it in comparative form. They are organized into three categories: Project Layout, Power Supply Configuration, and Land Exchange.

PROJECT LAYOUT

Project Layout includes the following components of the Project: mine site, mill and tailing area, ore haulage system, worker access system, production rate, mining method, mill water supply, potable water supply, and mitigation measures.

As the No Action alternative (Alternative 1) assumes no mine on Mt. Emmons, the Project area is expected to experience a 2-4 percent annual population growth.

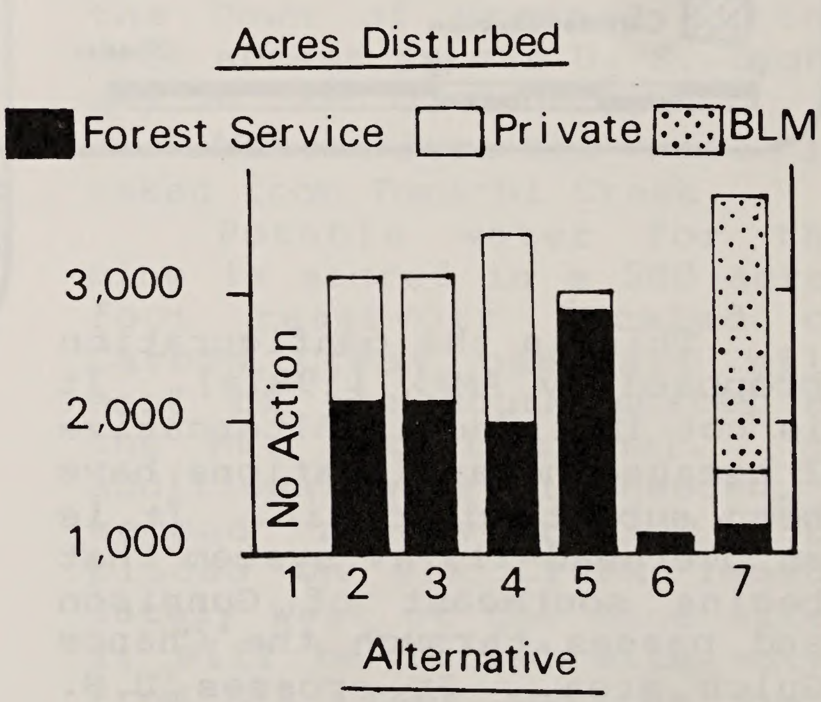
Vegetation

Wetlands will be impacted locally under all alternatives. The most significant impacts will occur under Alternatives 2-6 because of the wetlands that will be buried under tailing. At Alkali Creek (Alternatives 2-4), about 43 acres of natural wetland and 99 acres of irrigated haymeadow having wetland characteristics will be covered. At Carbon Creek, Alternative 5 will cover about 84 acres of natural wetland, while Alternative 6 will cover 53 acres.

Minor additional wetland acreage will be covered by the ore haulage routes. The greatest likely impact will come from Alternative 7, which could cover as many as 12 acres of natural wetland and 72 acres of irrigated hay meadow. Alternative 2 and 3 will cover about 11 acres of wetland at the Coal Creek crossing.

Housing construction may also impact natural wetlands, with the highest chance of impact coming under Alternatives 2-5 and 7, and the least under Alternative 1.

Acres disturbed on National Forest System, private, and Bureau of Land Management lands are shown in the following figure.



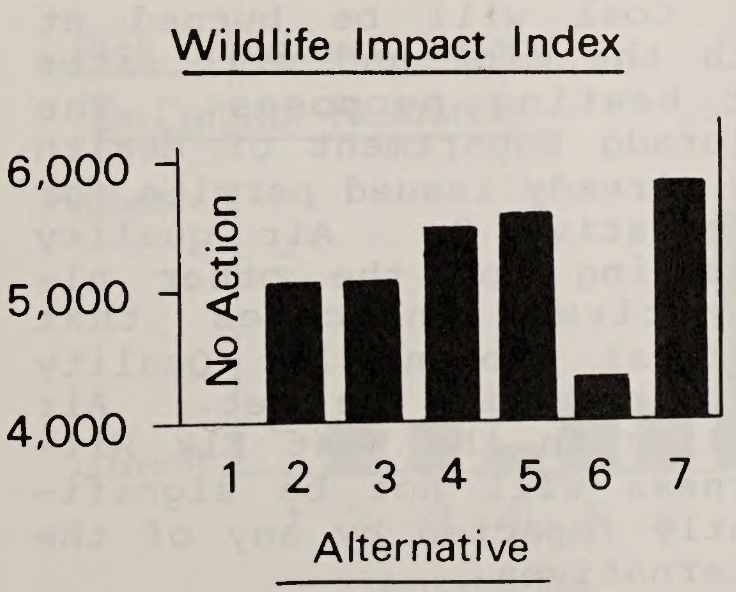
The Mt. Emmons Iron Bog supports the round-leaf sundew plant. It is not on the rare and endangered species list, but its only known occurrence in Colorado is in this Iron Bog. The bog is fed by acidic metals-rich spring water that has passed through the bedrock of Mt. Emmons. As mining the ore body will locally disrupt groundwater flow patterns in the mountain, the Bog could lose its water source. Under Alternatives 2-7, AMAX will take steps to maintain the Iron Bog's water supply. Under Alternative 1 this would not be necessary.

No threatened or endangered plants will be affected by any of the seven alternatives.

Wildlife

A herd of about 160 elk uses the area between Ohio Creek and the East River. It winters at low elevations on the south end of Flat Top and migrates to summer range further north. Placement of the mill-tailing area in Alkali Creek (Alternatives 2-4) will disrupt this migration pattern, but the effect is not expected to be significant.

Aggregate wildlife impacts are shown in the following figure. (Higher index values represent greater adverse impacts. Appendix I describes the methodology used in calculating wildlife impact indices.)



Hauling ore to the Chance Gulch mill site (Alternative 7) will not significantly impact the winter range at the south end of Flat Top.

Alternative 7 will displace an estimated 1,440 sage grouse and eliminate up to eleven strutting grounds used by these game birds in Chance Gulch. None of the other alternatives will directly affect sage grouse strutting grounds.

The impacts of local population growth on big game are likely to be greater due to general harassment than from any of the alternative locations. Thus Alternatives 2-5 and 7 will have the most impact.

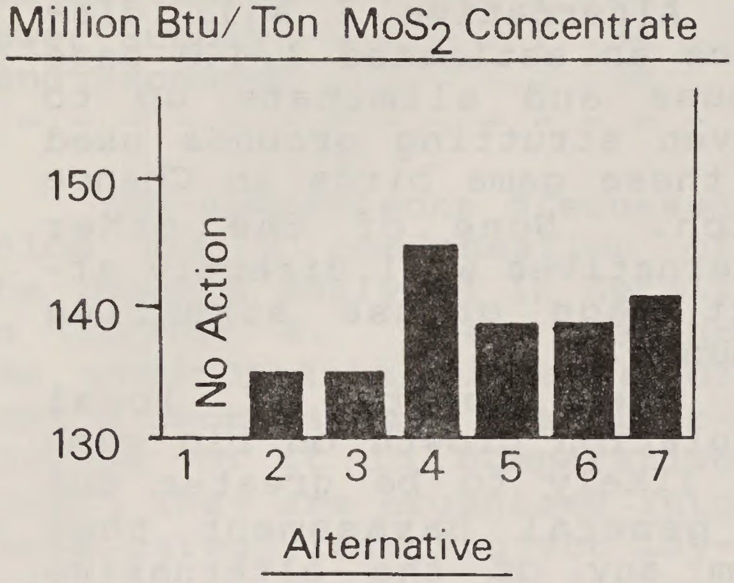
No threatened or endangered wildlife species will be affected by any of the seven alternatives.

Aquatic Ecology

Alternative 5 will have the greatest impact on aquatic ecology by eliminating about 3.6 miles of perennial stream in the Carbon Creek drainage. Alternatives 2 and 3 will route through pipes a total of about one mile of Coal Creek and Carbon Creek combined. Alternative 7 could affect less than 1,000 feet of perennial streams, principally on Carbon Creek, Gunnison River, and Tomichi Creek. The length of perennial streams affected by Alternatives 4 and 6 will be less than 500 feet. Alternative 1 will generate no direct loss of perennial stream habitat.

Energy

Comparative energy requirements are shown in the following figure.



Water

Temporary increases in suspended sediment will occur under all alternatives except No Action (Alternative 1). Significant adverse impacts are not expected from these increases. The area where the increases could be most problematic is in the Coal Creek drainage (Alternatives 2, 3, and 5-7); an increase in the frequency of turbidity standard violations can be expected for the Town of Crested Butte's water supply.

The risks of seepage from the tailing deposit are greatest under Alternatives 5 and 6 due to the geologic complexity in the Carbon Creek area. Lining the tailing disposal area at Chance Gulch (Alternative 7) should control seepage adequately, but if seepage did occur it would be difficult to detect at an early stage and may be impossible to correct. The risks of seepage at Alkali Creek are lowest (Alternatives 2-4), while the opportunities for early detection are greatest. Use of the Alkali Creek area will present an extremely low risk of water contamination at the Roaring Judy Fish Hatchery, while alternative water sources for the Hatchery are readily available.

Acid seepage could appear on the flanks of Mt. Emmons sometime after mine closure. The possibility of this occurrance is about the same for Alternatives 2-7. Post-mining control measures that could be taken have been discussed by AMAX, but it is premature to define the exact details of measures that will not be taken for 30 or 40 years. The technology of acid drainage control and prevention is improving steadily, and new methods may become applicable in the future.

A potable water reservoir will be constructed on Carbon Creek under Alternatives 2, 3, and 5-7. The maintenance of favorable flows below the reservoir will be best assured under Alternatives 3 and 5-7.

Maintenance of long-term tailing stability is least favorable under Alternative 5 because of the comparatively high flows of Carbon Creek.

Air

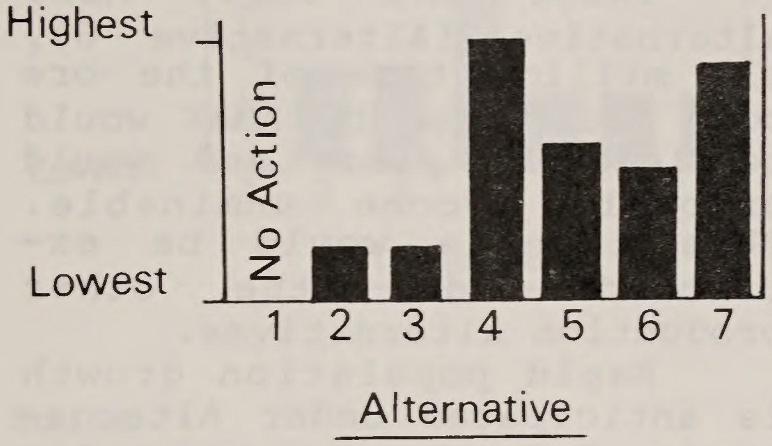
Coal will be burned at both the mine and mill sites for heating purposes. The Colorado Department of Health has already issued permits for Alternative 2. Air quality modelling for the other alternatives indicates that National Ambient Air Quality Standards will be met. Air quality in the West Elk Wilderness will not be significantly impacted by any of the alternatives.

Population growth will lead to an increase in secondary air emissions, which will be greatest under Alternatives 2-5 and 7, and least under Alternative 1.

Noise

Comparative noise impacts are shown in the following figure. The comparison is based primarily on the closeness of project facilities to towns and major travel routes.

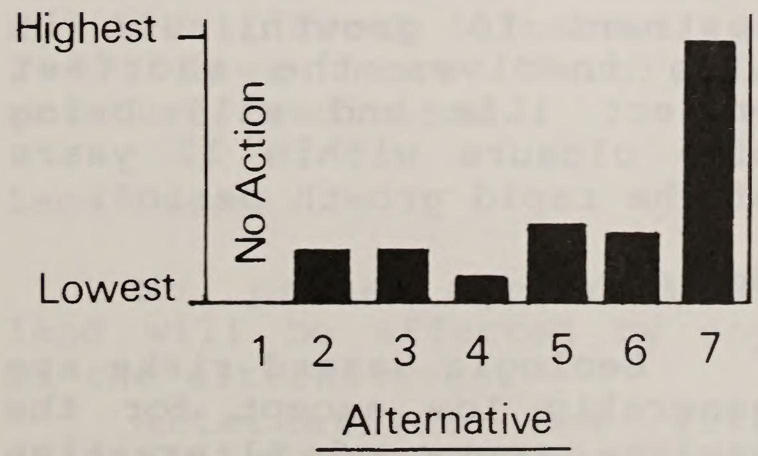
Risk of Adverse Noise Impacts



Cultural Resources

Archaeological values will be most disturbed by Alternative 7 because Chance Gulch is a highly sensitive archaeological area. Alternatives 1-4 will disturb archaeological values the least, as shown below.

Risk of Adverse Impacts On Cultural Resources

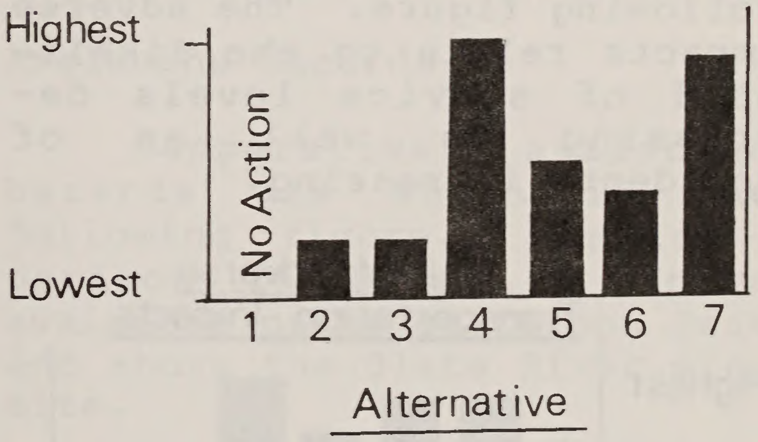


The mine site will be near the Crested Butte Historic District (Alternatives 2-7). It will be closest under Alternative 4, which also has the ore haulage route passing around the east side of the District. Regardless of which alternative is implemented, increased population and area use resulting from mining activity should have no effect on the historical or cultural character of the Historic District since it only continues the mining tradition which it represents.

Visual Resources

Comparative visual impacts are shown in the following figure. The comparison is based on the visibility of project facilities from towns and major travel routes.

Risk of Adverse Visual Impacts



Subsidence on Mt. Emmons will occur under Alternatives 2-5 and 7. It will not occur under Alternatives 1 and 6. If it occurs, the maximum area that could be affected is about 900 acres and would include the top of Mt. Emmons. The average amount of subsidence in this case would be about 50 feet, but it would be irregular. The affected area will be visible from the Towns of Crested Butte and Mt.

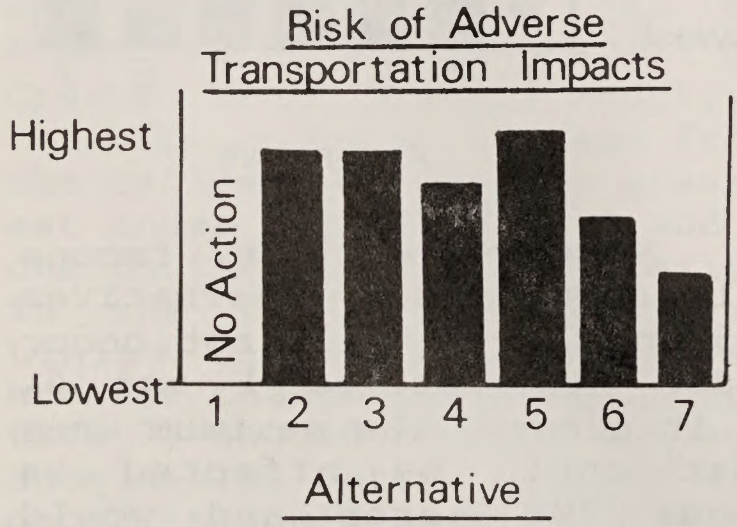
Crested Butte. The subsidence process will not be completed for several years following mine closure.

Outdoor Recreation

Outdoor recreation activities will increase under all alternatives, with Alternatives 2-5 and 7 generating the most increase and Alternative 1 the least. However, these differences will not be easily distinguishable because most recreation use in the area comes from people who do not live nearby.

Transportation

Impacts on road systems are related to Project employment levels, work locations, travel distances, and specific road capacities. The comparative transportation impact risks are shown in the following figure. The adverse impacts relate to the likelihood of service levels decreasing as well as of accidents increasing.



Socioeconomic

If the mine is not developed (Alternative 1), the 682,000 tons of molybdenum disulfide, or over 817 million pounds of molybdenum metal, in the Mt. Emmons ore body would not contribute to the world supply of molybdenum. Economic benefits (local, statewide, and national) of mining and processing the mineral deposit would not occur. These benefits include an increase in the local tax base, increased employment, payment of Colorado severence taxes totalling $23.25 million at present rates, and exports to foreign countries.

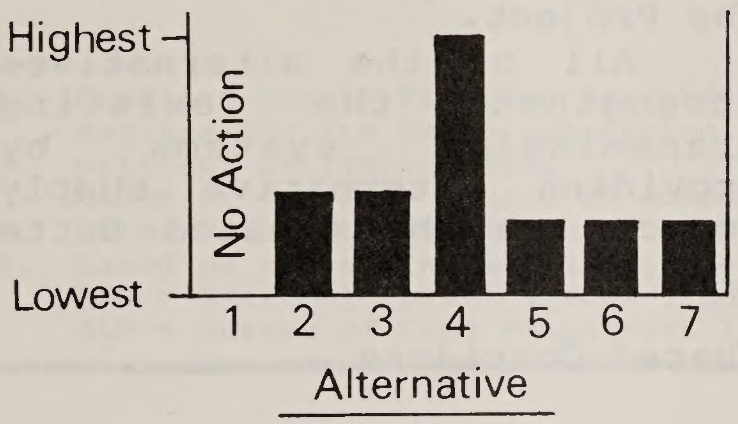
Under the Small Mine alternative (Alternative 6), 117 million tons of the ore body identified by AMAX would be left in place and would probably become unminable. This tonnage would be extracted under the other production alternatives.

Rapid population growth is anticipated under Alternatives 2-7, but even under Alternative 1 growth problems will be present. Alternatives 2-7 are similar in the sense that the types of growth pressures will be the same, and will differ mainly in degree. They will all require significant increases in housing, school capacity, and wastewater treatment capacity, to name only a few. The growth center will be the City of Gunnison. Among Alternatives 2-7, Alternative 6 will require the least local adjustment to growth, but it also involves the shortest project life and will bring mine closure within 12 years of the rapid growth period.

Geology

Geologic hazard risks are generally low except for the haulage route of Alternative 4, which crosses geologically unstable terrain that could seriously disrupt ore haulage if past landslide movements became reactivated.

Comparative geologic hazard risks are shown in the following figure.



Risk of Adverse Geologic Impacts

Soils

Acres of soil disturbance are shown in the figure under Wildlife, while the impacts of these disturbances are discussed under Water.

The reclamation potential of disturbed soils is similar for Alternatives 2-7, but climatic variations lead to some differences. Chance Gulch (Alternative 7) is comparatively dry and has the least favorable climate for tailing area revegetation. Carbon Creek (Alternatives 5 and 6) and Alkali Creek (Alternatives 2-4) have more favorable moisture conditions.

Land Uses

No prime agricultural land will be affected by any of the alternatives.

Alternatives 2-4 will directly affect the most nonprime agricultural land. Alternatives 1, 5, and 6 will directly affect no agricultural land, while Alternative 7 will be intermediate in its direct affects on agricultural land.

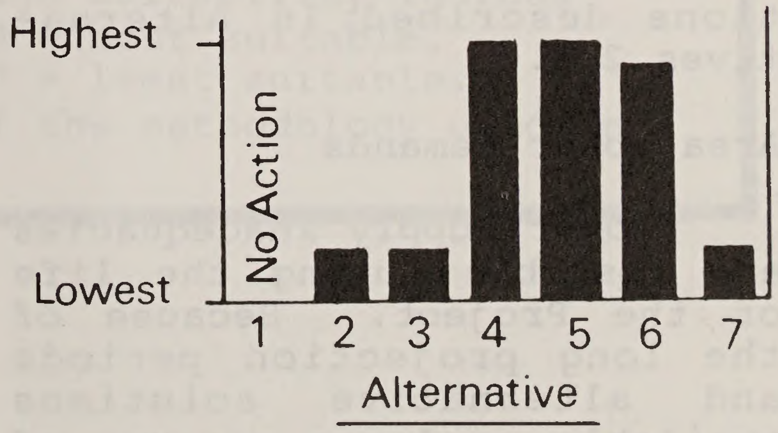
More significant effects on agricultural land will occur indirectly from population growth. As population increases in Gunnison County, more land will be used for urban, suburban, commercial and industrial purposes. There is a high probability that much of this land will come from the agricultural sector. The demand for land use change will be greatest under Alternative 7, slightly less under Alternatives 2-5, slightly less again under Alternative 6, and least under Alternative 1.

National Forest timber production will not be significantly affected by any of the alternatives.

Avalanche Hazards

Comparative avalanche hazards are shown in the following figure. The comparison is based on known avalanche paths on Carbon Peak and above the Slate River mine site.

Risk of Adverse Avalanche Impacts



POWER SUPPLY CONFIGURATION

Alternative power supply configurations are discussed below. The power supply category includes the following items necessary for delivering power to the Project: electrical source, delivery method, voltage, corridor location, and mitigation measures.

Alternative 1 (No Action) involves increasing demands for electrical energy due to an assumed 3 percent average annual population growth rate. This increasing demand means that some improvements, possibly one of those listed in Chapter 4, will be added before 1995 to make more power available in the GCEA service area. This could include the construction of a new high voltage transmission line. Since this possible action is over 10 years in the future and may have different demand or delivery points, it cannot be fully evaluated in this draft EIS. The impacts described in Chapter 4 are typical of those that would occur, but the Forest Land and Resource Management Plans currently being developed will identify corridors suitable for future utility location.

The following discussions and Tables compare the effects of the power supply configurations described in Alternatives 2-7.

Area Power Demands

Power supply inadequacies are possible during the life of the Project. Because of the long projection periods and alternative solutions available, a large measure of uncertainty exists regarding future adequacy. It is possible that only Alternatives 5 and 6 will adequately supply all of the area's power demands for the life of the Project. The other alternatives may require additional transmission line construction before the Project is completed.

Ignoring secondary demands, all of the alternatives can adequately supply the power required by the Project.

All of the alternatives strengthen the existing transmission systems by providing alternative supply sources to the Crested Butte area.

Shared Corridors

Table 2-3 describes the miles of corridor shared between the Power Supply Configuration alternatives, and either existing transmission lines or other Project facilities.

Also reflective of shared corridors is the construction access index determined by CDM (1981c). The alternative with the greatest amount of existing access is 4, with the other alternatives, ranked in descending order: 3, 2, 7, 5, and 6. The alternatives with the least access, 5 and 6, may require the most new construction of access roads and can result in more adverse visual impact than the others.

Environmental Suitability

Environmental suitability indices developed by CDM (1981c) for each of the corridor segments were combined into an average index for each alternative configuration. These are shown in Table 2-4.

TABLE 2-3. COMPARISON OF POWER SUPPLY CONFIGURATIONS

Alternative #	Midline Length Miles	Services Skito Sub[1]	Capital Cost[2]	Common Corridor Miles[3]	Land Status, Miles[4] NFS	BLM	Other
2	77	Yes	$20.80	18	35	8	27
3	70	Yes	19.10	27	39	8	23
4	73	Yes	19.50	33	32	8	33
5	70	Yes	24.90	13	34	11	25
6	70	Yes	28.2-37.5	13	34	11	25
7	67	No	18.90	12	38	13	16

---

1. Gunnison County Electric Association has long range plans that require service for its Skito substation west of Gunnison.
2. Millions of 1981 dollars.
3. Miles of corridor shared in common by power supply configurations and either project facilities or existing power transmission facilities.
4. Based on centerline measurement.

NFS = National Forest System land
BLM = Bureau of Land Management land

TABLE 2-4. POWER CORRIDOR SUITABILITY*

IMPACT CATEGORY	POWER SUPPLY CONFIGURATION ALTERNATIVE 2	3	4	5&6	7
Visual	192.5	189.6	187.9	193.9	195.9
Vegetation	200.6	192.8	197.1	189.1	191.8
Wildlife	178.2	199.0	196.3	191.7	207.0
Archaeology	269.6	270.5	217.4	267.0	254.9
Geologic Hazards	233.8	224.8	223.9	228.8	221.9
Engineering	214.8	206.5	208.7	207.0	207.2
Soils	203.5	198.0	202.4	195.6	195.0

*Table values are weighted-average suitability indices based on data in CDM (1981c). 300 = most suitable.
100 = least suitable.

See Appendix I for a discussion of the methodology used in calculating these indices.

Other Impacts

Although Alternatives 2-7 cross some prime irrigated agricultural land in Delta County, no detrimental impacts are expected from transmission line construction that is carefully mitigated.

No threatened or endangered plants or animals will be affected by any of the alternatives.

LAND EXCHANGE

The following discussion describes the effects of exchanging lands as proposed and of not exchanging lands. It is assumed that a decision to proceed with the land exchange will require the Forest Service to conduct further environmental analysis of the land exchange proposal and to approve the proposed land classification described in Appendix E. Although revising land classifications has no significant environmental effects, the implications to be considered by the Regional Forester are discussed in Chapter 4.

NFS Resources

If lands are exchanged, NFS resources will be gained through acquisition of the offered lands, and lost through disposal of the selected lands. Because an exchange is based on land values and not on equal acreages, the final balance sheet of resources cannot be determined until appraisals are completed and approved.

If lands are not exchanged, some NFS resources will be lost for public use without compensation.

Forest Service Administration

If lands are exchanged, Forest Service approval and administration activities will not be required after title is transferred. This could mean a significant saving in Forest Service staff and budget requirements.

If lands are not exchanged, the Forest Service will be required to make time-consuming reviews and administer Project activities affecting surface resources on NFS lands for the life of the Project. The Forest Service has already identified many of the offered lands as being in the public interest to acquire. Frequently, a reason for this determination is to reduce the potential for unauthorized occupancy problems. The exchange, as proposed, will effect a net reduction in the miles of boundary between NFS lands and non-NFS land. Additionally, the exchange will result in a net decrease in the number of property corners requiring Forest Service maintenance. Both of these reductions will result in savings of public funds.

State and Federal Regulation

If Federal lands are exchanged, they will no longer be subject to Forest Service regulations. As a result, some Project activities will no longer be subject to NEPA analysis. Other applicable Federal and State regulations will remain in effect whether the lands are exchanged or not. Consequently, some Project activities may still be subject to NEPA analysis.

Project Construction

Project construction will not be significantly affected by land exchange proceedings.

If lands are exchanged, Project construction on selected lands will no longer require approval by the Forest Service, but other Federal laws, State laws and Gunnison County land use controls will still apply.

Prior to completion of the land exchange, or if lands are not exchanged, project construction on selected land areas could proceed under the authority of either the Forest Service's mining regulations, or special use permits issued under the Organic Act of June 2, 1897, the Term Permit Act of March 4, 1915 and FLPMA. All activities affecting surface resources on NFS lands will require Forest Service approval.

Gunnison County Tax Base

If lands are exchanged, Gunnison County will experience a net increase in private property tax base acres and an increase in tax revenues because of a change in use. There will be a decrease in National Forest base acreage used for payment-in-lieu of taxes (PILT) and 25 percent National Forest receipts calculations, but this will be more than offset by the property tax increase.

If lands are not exchanged, Gunnison County will experience no change in its property tax base acres but will benefit from taxes on capital improvements of the Project. Additional revenues will be received from 25 percent National Forest receipts, but these probably will not offset the loss in property taxes.

Other County Tax Bases

Boulder, Conejos, Douglas, Eagle, Garfield, Larimer, Rio Grande, Routt, Saguache, and San Juan counties will experience a net decrease in their private land tax base if the exchange is completed. Equal acreages will be added to the National Forest base for PILT and National Forest Fund receipts calculations for National Forest payments to the Counties.

AMAX Investment Climate

If lands are exchanged, AMAX will obtain more certain control of lands on which it proposes substantial capital investment. Such control will most likely make it easier for AMAX to reach decisions about investing in the Project.

If lands are not exchanged, the situation described above will be reversed and there may be a tendency to limit investments on NFS lands.

FOREST SERVICE PREFERRED ALTERNATIVE

The Forest Service Preferred Alternative is Alternative 3, including further analysis of the proposed land exchange and modifications to the proposed exchange. It also includes the proposed land classification described in Appendix E.

ALTERNATIVES ELIMINATED FROM FURTHER DETAILED STUDY

PAGE REFERENCE

Mine Site. 38
Mill Site. 38
Ore Haulage. 38
Power Supply 40
Worker Access. 41
Production Rate. 42
Mining Method. 42
Land Exchange 42
Schedule 43
Workforce Estimates. 43
Local Source Materials . . .44

MINE SITE

AMAX inventoried several sites in the Coal Creek drainage besides the one proposed. The Interdisciplinary Team considered them but did not study any of them in detail because it was obvious they did not offer a distinct advantage over the proposed site. The north side of Mt. Emmons was considered, but the area was not studied in detail because of obvious avalanche hazards.

MILL SITE

AMAX initially inventoried 61 possible tailing locations. The Interdisciplinary Team reviewed this list (Forest Service, 1979a), and through the application of several basic criteria reduced the sites to three: Alkali Creek, Antelope Creek and Cabin Creek. Subsequent public input led to an expansion of the list to include Chance Gulch and Carbon Creek (Forest Service, 1979b). Following further review (Forest Service, 1980a) the Cabin Creek and Antelope Creek sites were deleted from further study because they conflicted with critical big game winter range and offered no distinct advantages over the three sites analyzed in this EIS.

The Chance Gulch alternative (Alternative 7) includes a lining placed under the tailing deposit to prevent seepage into the permeable materials underneath. AMAX's version of this alternative does not include a lining. The Forest Service did not analylze the AMAX version for two reasons:

(1) A design with such a high likelihood of seepage water entering the Tomichi Creek hydraulic system was not considered reasonable.

(2) Even though a substantial expense would be incurred in lining the basin, the Forest Service had no firm basis for judging that it would make the design economically infeasible.

ORE HAULAGE

Alkali Creek Mill Site

It would be possible to use a double-track system and/or diesel locomotives for hauling ore. These variations on AMAX's proposal were not analyzed in detail because they offered no distinct advantages.

AMAX analyzed conveyor haulage to this site and concluded that it was not technically feasible due to slope stability problems (AMAX, 1979b). The Interdisciplinary Team agreed with this conclusion.

Carbon Creek Mill Site

Rail haulage to the mill was not analyzed in detail even though it appeared desirable to have an alternative means for reaching the site. However, a route through Splains Gulch would have a grade of about 10 percent, and a route through the Ohio Pass area would have grades locally approaching 5 percent. Both of these are steeper than grades ordinarily used in the industry (Brauns and Orr, 1968), and were not considered reasonable.

Chance Gulch Mill Site

The suggestion has been made that another western route could be developed through the Ohio Pass area. This would involve a tunnel from the underground workings to a point just south of Ohio Pass, with surface haulage down the Ohio Creek valley. This would have the advantage of avoiding impacts in the Carbon Creek valley, but at the same time it would bring the railroad closer to the heavily-travelled Ohio Pass road. In addition, the alternative has engineering problems that make it appear technically infeasible. For example, if a single tunnel were driven from the mine to the Ohio Pass portal, it would have to pass about 200 feet underneath Coal Creek. In an area of complex geology, this would incur a risk of dewatering Coal Creek and flooding the tunnel. If, instead, the tunnel were brought to the surface in order to cross Coal Creek, then its grade would be steeper than the industry ordinarily prefers to use (Brauns and Orr, 1968).

An additional variation not analyzed in further detail is the corridor following the East River (shown on Map 1 in the back packet). Other than the possible mass transit advantage which is discussed below, this route offers no distinct advantage over the Ohio Creek corridor. Particularly troublesome would be locating the railroad in the narrow part of the canyon near Almont.

Mass Transit

A local issue recommended using the Chance Gulch alternative and an ore haulage system that would serve both the mine's needs and also provide mass transit along the East River valley between Gunnison and the Crested Butte area. This idea was not studied in detail, for several reasons.

(1) If major metropolitan areas are having difficulty financing the construction and operation of mass transit rail systems, then the Gunnison area's smaller economic base would likely be unable to support one. Obtaining grants might help alleviate some of the problem, but they do not guarantee long-term support.

(2) It is unrealistic to assume that AMAX could be required to construct such a system.

(3) A mass transit bus system already exists. It could simply be expanded to accommodate increased travel volumes associated with project-induced population growth.

POWER SUPPLY

Only One Source

The alternative of having only one power source was not considered reasonable because it could jeopardize worker safety and project efficiency.

Onsite Generation with Coal or Diesel Fuel

AMAX's Environmental Report (AMAX, 1981a, Section 5.5.5.3) describes environmental and socioeconomic impacts associated with coal-fired and diesel-fired power plants capable of providing a peak power requirement of 55 mW. Engineering, economic and technical considerations are also presented. The economic and environmental costs associated with this alternative were considered unacceptable through interdisciplinary analysis by the Forest Service. Therefore, this alternative was not considered in further detail.

Parallel Transmission Lines

Parallel lines offer the advantage of having only one corridor. If such a system were feasible, then one leg of the proposed loop could be avoided. However, it has been determined that an adequate power supply is not available in the Gunnison area under normal operating conditions. Further, a parallel system to the western electrical source points has a disadvantage because both sides of the system would have to pass through the same corridor segment from Kebler Pass to Marcellina Mountain. With both sides of this system passing through the same terrain and in close proximity, the reliability of the system would be only slightly better than a single line. Any major disruption, such as slope failures or severe electrical storms, could damage both sides of this system.

Finally, as the corridor segment from Kebler Pass to Marcellina Mountain has been identified as a visually sensitive area, the location of a double set of towers and lines through it was considered an undesirable impact.

For these reasons, a parallel transmission system was not analyzed in further detail.

Other Corridors

Corridors other than those shown in Appendix D, Figure D-2, were not analyzed in detail. However, those shown are the product of a broad analysis that included other areas to begin with (CDM, 1980e).

Cogeneration

One issue asked that the company generate electricity onsite using cogeneration technology. This technology applies varied configurations to obtain dual use from industrial process heat or steam.

Cogeneration within the design requirements of AMAX as described in the Plan of Operations was determined to be financially infeasible because the plant's net process steam demand is too low (i.e., less than 50,000 pounds per hour) to justify owning and operating a cogeneration plant (DOE, 1979). Therefore, this alternative was not studied in further detail.

Hydroelectric Generation

It is questionable that sufficient water is available near Project work sites to generate the amount of power needed. Major environmental impacts would be involved. In addition, the long lead time required to plan and construct such a facility, even if sufficient water were available, would likely make this alternative unreasonable.

Solar Generation

Using solar cells onsite to reduce the need for power transmission is neither reasonable nor feasible for the Mt. Emmons Project.

The scale of power demand (1122 mWH per day) is larger than current solar technology can contribute to significantly. Costs would be considerably greater than even the total costs of building transmission lines and purchasing power for the life of the project. With the high snowfall conditions in the project area the task of keeping over 40 acres of solar cells free of snow is impractical. Finally, the techniques available to provide a stable power supply even during dark hours, such as pumped storage, could potentially create additional significant adverse environmental impacts.

Nuclear Generation

Generation of nuclear power is not economical at the scale required by the Project, and the potential environmental impacts would be great.

WORKER ACCESS

Mine Site

Worker access through the Town of Crested Butte was not analyzed in detail because the traffic impacts on the town would be unreasonably high. Worker access to the Coal Creek site via Splains Gulch was not analyzed because a grade of 10 percent would be required, and this exceeds the grade standards of both the Forest Service and the State of Colorado for a Class D (arterial) type road.

Mill Site

Worker access to the Alkali Creek site via the south side of Alkali Basin was not analyzed in detail because during winter months there would be no sunlight to help keep the road clear of snow and ice, which is a disadvantage when compared to the route proposed by AMAX. Access to the mill from the west was not analyzed in detail because it offered no distinct advantage over the eastern route.

Worker access to the Carbon Creek site via the existing Ohio Creek road was not analyzed in detail because it did not offer any distinct advantages over the route that passes along the east side of the tailing diposal area. A road would have to be built through the latter area anyway, and it was reasoned that this road could serve all of the mill workers and keep the traffic off of the Ohio Pass road, which is a popular tourist route.

PRODUCTION RATE

Over 30,000 Tons Per Day

No rate in this range was analyzed in detail even though at one time 40,000 TPD was identified as an alternative by the Forest Service (Forest Service, 1980b). It was concluded that 30,000 TPD provided an adequate bracket on the high side of AMAX's proposed 20,000 TPD, and to go higher would be speculative and not provide enough useful information to justify the effort at this time.

Project Layout at 10,000 Tons Per Day

It has been suggested that the project layout for the "Small Mine" should resemble AMAX's proposal, which involves the panel caving technique and the Alkali Creek mill site. This does not appear to be economically feasible. The Bureau of Mines (Steckley and Lemons, 1980) performed a validation study of AMAX's first major feasibility analysis, which involved the proposed panel caving-Alkali Creek configuration. AMAX's figures were confirmed, indicating a very low rate of return. Since that time, AMAX has worked at reducing the construction and operating costs of this configuration in order to increase the rate of return. Presumably this process continues until a rate of return meeting corporate requirements is achieved. To take this design, then, and reduce the production rate by half would clearly put the rate of return back below the level of acceptability. Thus, this version of the "Small Mine" is not economically feasible.

MINING METHOD

Open Pit

This alternative cannot be legally required. In addition, the surface impacts of an open pit would be far greater than with an underground mine.

Room and Pillar at 20,000 TPD

This method is used for the 10,000 TPD alternative, but not for the higher production rates. While the method might successfully avoid surface subsidence, it would require leaving nearly half of the ore body irretrievably in place. When so much more ore could be taken using the panel caving technique, it would be wasteful not to take it. Also, it is unlikely that any level of government has the authority to require that the method be used.

Panel Caving at 10,000 TPD

This method is used for the 20,000 and 30,000 TPD alternatives, but not for 10,000 TPD. This is due to Project economics, which render the method infeasible for the Small Mine alternative.

LAND EXCHANGE

An alternative to the Forest Service acquisition by exchange of the tracts offered by AMAX is to purchase them using funds available through the Land and Water Conservation Fund (L&WCF). This alternative was not analyzed because the tracts have not been identified for purchase under this authorization, funds are limited, and many of the tracts would not meet the criteria and requirements to qualify for L&WCF purchases.

Another alternative to proceeding with analysis of the land exchange proposal is to reject the proposal entirely. However, neither the public interest nor the management of NFS lands would be served by such an early rejection. Considering that the exchange offer has been made even though the Project is authorized under the 1872 Mining Laws, this alternative was not analyzed in detail.

SCHEDULE

AMAX currently plans to begin construction in the mid-1980's and reach full operating capacity in the early-1990's. (See Appendix G.) This schedule will probably be modified before the Project is completed, but it is speculative to guess how great the change will be.

It has been suggested that some other time in future years (or perhaps decades) would offer 'better' circumstances for initiating the Project. This, too, is speculative.

It has also been proposed that, by extending the construction period over more years, problems associated with rapid growth could be reduced. This may be, but the legal feasibility of requiring AMAX to do this is questionable. Besides, problems related to rapid growth are not entirely due to rates of population influx; the responsiveness of local governmental systems is also an important factor. As a result, alternatives to the basic schedule were not analyzed.

It should be pointed out that on a more refined scale AMAX has already attempted to minimize the construction period workforce peak. This was accomplished by adjusting, to the extent possible, the construction schedule so that work on major components will not overlap.

WORKFORCE ESTIMATES

AMAX provided Briscoe, Maphis, Murray and Lamont (BMML), who were social and economic consultants studying Project impacts, with workforce estimates for both construction and operation. These were quarterly estimates covering the life of the project. It has been suggested that, when compared to AMAX's last major mine in Colorado (the Henderson Mine), the construction workforce estimates appear low. AMAX has responded by saying that the critical path for Mt. Emmons construction is different from the Henderson's, and that Mt. Emmons is more distant from the Denver labor pool. Thus it contends that a precise correlation between the two projects cannot be made. The realities of construction dictate that activities may have to be shifted from one quarter, or year, to another. Uncertainties, such as the length of any given summer season, render it so. Thus it would be speculative to analyze alternative workforce estimates.

LOCAL SOURCE MATERIALS

AMAX has not yet identified a source of its sand and gravel requirements. Because of this, no alternative locations were analyzed. The general impacts of sand and gravel operations are discussed in Chapter 4.

The same holds for AMAX's coal requirements.

CHAPTER 3. AFFECTED ENVIRONMENT

CHAPTER 3. AFFECTED ENVIRONMENT

PAGE REFERENCE

Vegetation. 45
Wildlife. 50
Aquatic Ecology 53
Energy. 54
Water 56
Air 63
Noise 65
Cultural Resources. 65
Visual Resources. 66
Outdoor Recreation. 68
Fire. 74
Transportation. 74
Socioeconomics. 75
Geology 90
Soils 94
Land Uses 95
Avalanche Hazards 97

This Chapter describes the environment affected by the alternatives defined in Chapter 2. Much information is available, but this Chapter does not include it all; rather, it relies on the provision in the Council on Environmental Quality's Regulations that encourage incorporation by reference (40 CFR 1502.21). Many topics in the following pages are discussed briefly, with the pertinent source reports identified and incorporated by reference. Other categories are treated in more detail. These are topics that either involve important issues or do not have easily-referenced material to back them up.

AMAX's Environmental Report (1981a, Chapter 4) contains descriptions intermediate in detail between those presented in this chapter and the material incorporated by reference.

A microfiche system has been established to make the incorporated material reasonably available. The details on this system are discussed in Chapter 1.

VEGETATION

REGIONAL SETTING

"The vegetation types in the project area consist of forests, shrublands, and grasslands, occurring in four major elevational zones (Langenheim, 1962). The zones are not distinct and tend to overlap and intergrade, especially in local areas where slope and aspect alter general elevation trends. The alpine tundra zone (above 11,500 feet) includes fellfields and tundra meadows. The subalpine zone (9,500 - 11,500 feet) includes subalpine meadows, subalpine willow thickets, spruce-fir forests, wet sedge meadows, and sphagnum-sedge bogs. The upper montane zone (8,500 - 9,500 feet) includes Douglas-fir forests, lodgepole pine forests, aspen woodlands, riparian willow thickets, moist meadows, and mountain grasslands. The lower montane zone (7,700 - 8,500 feet) includes sagebrush shrublands, cottonwood woodlands, ponderosa pine forests, juniper woodlands, and hay meadows-pastures." (AMAX, 1981a)

The concept of vegetation zones only applies in a general way. For example, sagebrush shrublands in the Project area can occur at elevations as high as 12,000 feet (Langenheim, 1962).

TABLE 3-1 VEGETATION TYPES IN THE PROJECT AREA

VEGETATION TYPE	Acres	Percent of Total Area
Moist Meadow	209	0.15
Mountain Grassland	3,433	2.44
Wet Sedge Meadow	504	0.36
Sphagnum-Sedge Bog	9	0.01
Subalpine Meadow	8,105	5.77
Alpine Meadow	1,081	0.77
Alpine Fell-field	1,140	0.81
Sparsely Vegetated Area	1,390	0.99
Big Sagebrush Shrubland	50,626	36.03
Subalpine Willow Thicket	920	0.65
Cottonwood Woodland	1,273	0.91
Ponderosa Pine Woodland	3	<0.01
Lodgepole Pine Forest	2,624	1.87
Douglas-fir Forest	3,416	2.43
Aspen Woodland	19,723	14.04
Engelmann Spruce-Subalpine Fir Forest	21,110	15.02
Hay Meadow Pasture	15,685	11.16
Disturbed Area	372	0.27
Urban Area	584	0.42
Rock Outcrops/Talus	4,781	3.40
Riparian Willow Thicket	3,304	2.35
Juniper Woodland	18	0.01
Ponds, Lakes, and Reservoirs	214	0.15
TOTAL	140,524	100.00 %

- - - - -

Source: Stoecker-Keammerer (1980)

Table 3-1 lists the vegetation types in a 140,524 acre 'project area' which extends from about 5 miles north of Crested Butte to the south slopes of Flat Top Mountain and from approximately a mile east of the East River to a mile west of Ohio Creek. Big Sagebrush shrublands are the most extensive vegetation type, as they cover more than twice as much area as the second most abundant type, spruce-fir forests.

More detail on vegetation can be found in the following reports, which are incorporated by reference: Stoecker-Keammerer (1980); CDM (1980z, 1981b); and AMAX (1981a).

MINE AREAS

The vegetation of the Red Lady Basin, Keystone Mine and Coal Creek area is characteristically upper montane, subalpine and alpine in nature. The lower elevations are characterized by a mosaic of aspen woodlands, subalpine meadows, and spruce-fir forests. Extensive stands of lodgepole pine occur in Coon Basin northeast of Red Lady Basin. At higher elevations the woodland-meadow mosaic gives way to expanses of sparsely-vegetated rocky areas. Alpine meadows and fellfields occur above tree line on Mt. Emmons.

The vegetation at the Slate River mine site, in addition to the above vegetation types, includes moist meadow and riparian willow thickets.

MILL AREAS

Alkali Basin - "The vegetation in Alkali Basin is composed primarily of two vegetation types. Big sagebrush shrublands occupy 72 percent of the basin and occur on all slopes and aspects. The aspen woodlands are the second most abundant type occupying 16 percent of the basin. The woodlands are much more abundant on the south (north-facing) side of the valley.

"Isolated aspen stands occur on the north side of the valley. Mountain grasslands occur as scattered stands on exposed ridges and adjacent to moist meadows on the bottom of the basin. A limited number of sparsely vegetated areas occur on the south flank of Red Mountain. Stands of Douglas fir occur on the upper north-facing slope of Flat Top. At the base of the basin, isolated stands of juniper occur on the south-facing slopes.

"The wetlands of Alkali Basin are comprised of four subtypes of vegetation (beaked sedge, Baltic rush, tufted hairgrass, and willow thicket) and are the result of natural occurrence and man-made irrigation practices. These types are associated with surface water drainage, seasonal or perennial emergence of underground water, snowbanks, and soil moisture and oxygen tension regimes (CDM, 1981b). According to the Fish and Wildlife Service classificaiton of wetlands (Cowardin, et. al., 1979), both emergent (beaked sedge, Baltic rush, tufted hairgrass) and scrub-shrub (willow thicket) are included." (AMAX 1981a)

Carbon Creek - "Vegetation in the Carbon Creek area consists of Engelmann spruce-subalpine fir forest types along the east and north sides of Carbon Peak. Stands of lodgepole pine and numerous rock outcrops and talus slopes are intermixed in this area. The west and south aspects are dominated by aspen woodlands, mountain grasslands, and subalpine meadows. The bottomlands along Carbon Creek are primarily riparian willow thicket with talus slopes reaching to the creek in some areas. Beaver activity along Carbon Creek has created moist meadows and promoted the growth of willows while controlling the encroachment of aspen into the creek bottoms. Little or no man-made irrigation occurs in this area." (AMAX, 1981a)

Chance Gulch - "The vegetation of Chance Gulch is dominated by big sagebrush and is similar to the big sagebrush shrubland type found in Alkali Basin. Big sagebrush shrublands cover 66 percent of the Chance Gulch area. The remainder of the area is covered by black sagebrush (12.5

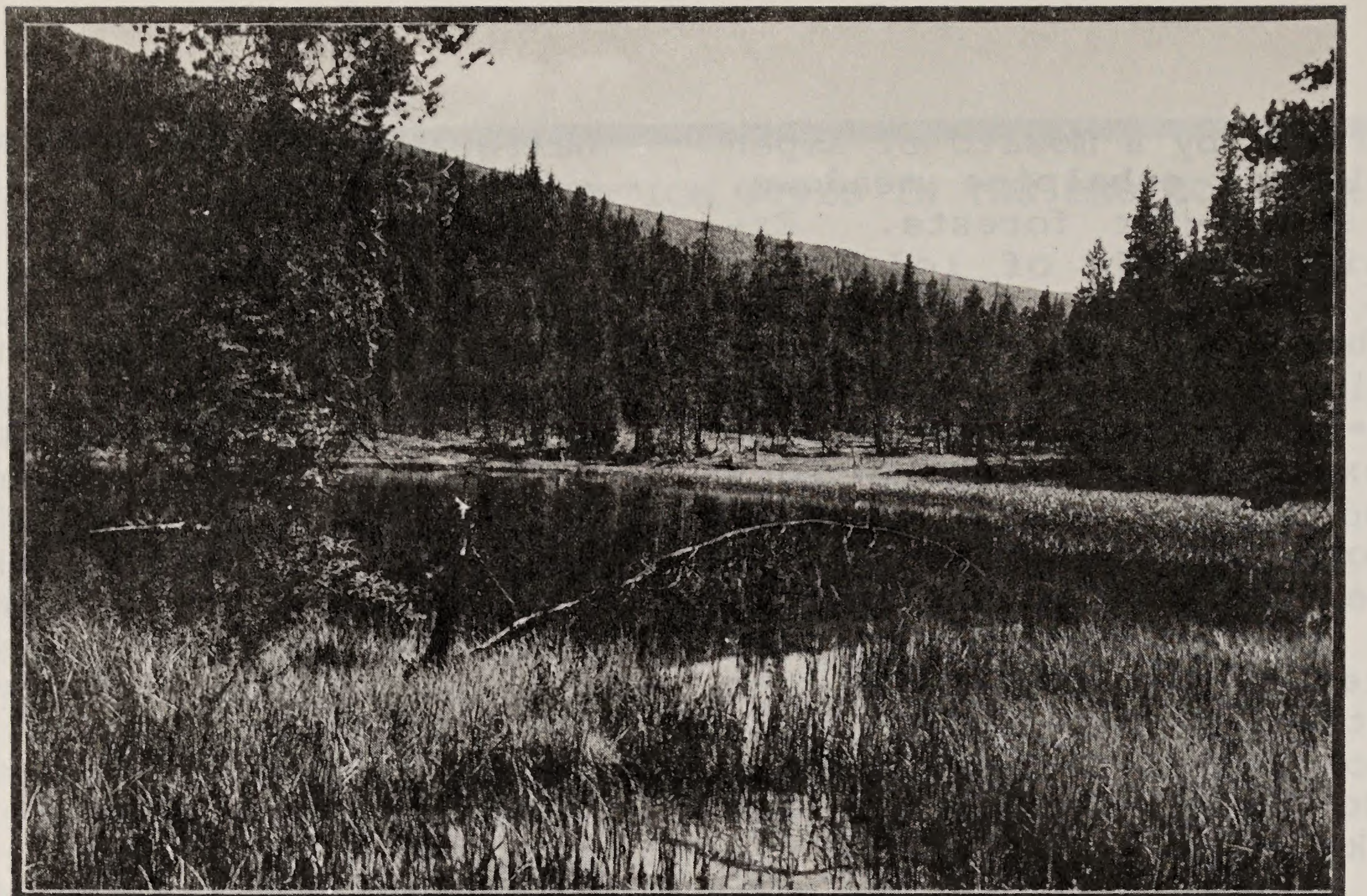


Figure: 3 - 1

MT. EMMONS IRON BOG.

Figure: 3 - 2

ASPEN "FINGERS" ON RED MOUNTAIN ARE A MAJOR BIG GAME MIGRATION PATH.

percent), pastures, and hay meadows along Tomichi Creek (20 percent). Other types (1.5 percent) include seeded areas, cottonwood woodlands, riparian willow thickets, disturbed areas and others." (AMAX, 1981a)

SENSITIVE AREAS

General - Sensitive areas are those which are highly susceptible to external disturbing influences. They have a low regeneration potential and high scientific value. The alpine tundra areas (meadows and fellfields) occupy 2,221 acres and are sensitive in that the tundra communities require long time periods to reestablish.

Mt. Emmons Iron Bog - Reports were submitted to the Forest Service in 1978 describing a unique round-leaved sundew population in the Iron Bog on the south slope of Mt. Emmons (Figure 3-1). The plant, Drosera rotundifolia L., is a small carnivorous organism found in peaty or wet, acid soils across the northern border of the United States and along both coasts. According to Britton and Brown (1970), it occurs "in bogs or wet sand, Newfoundland to Alaska, south to Florida and Alabama, in the Rocky Mountains to Montana and Idaho, and in the Sierra Nevada to California. Ascends to 2,500 feet in the Catskills. Also in Europe and Asia."

This population of 500-1,000 round-leaved sundew plants is of interest because it is the only known occurrence in the Central or Southern Rocky Mountains in spite of extensive searches for it in similar bogs. No other species of the Sundew Family (Droseraceae) have been found in Colorado. There is general agreement that this population is unique and sensitive (AMAX, 1981a; Field Report by the Forest Service and Rocky Mountain Biological Laboratory, August 4, 1978, in Forest Service files).

In addition to the sundew plant, representatives of Rocky Mountain Biological Laboratory (RMBL) have suggested that two other organisms found in the vicinity of the Iron Bog are rare in Colorado. These organisms are Leucorhinea hudsonica, a dragon fly (common name: white-faced skimmer), and an algae, Zygnema. RMBL representatives believe that the Iron Bog is the southernmost breeding habitat of the white-faced skimmer, but they have less information on the uniqueness of Zygnema. AMAX, however, has concluded that these organisms are probably not rare in Colorado (AMAX, 1980d).

On December 9, 1980 the Colorado Natural Areas Council voted to register the Mt. Emmons Iron Bog in the Colorado Natural Areas Program (CNAP). A vote to register an area in the program is taken only with the landowner's permission, but it involves no legal responsibility on the part of the State or the landowner. The Director of CNAP has strongly encouraged the Forest Service to design and include management plans which will ensure that the bog and natural springs which feed it will remain in an undisturbed condition (CNAP, 1981). One method that may accomplish this is to create a Special Interest Area that includes the Iron Bog.

THREATENED AND ENDANGERED SPECIES

No threatened or endangered plant species occur on the Gunnison National Forest (Forest Service, 1981d). The Fish and Wildlife Service (1980) has identified plant species in Gunnison County for which threatened or endangered status is probably appropriate, but more information needs to be gathered first. These species are: Arabis gunnisoniana (Gunnison Rockcress), Aquilegia barnebyi (Barneby's Columbine), Astragalus microcymbus (skiff milkretch), and Gilia penstemoides.

WILDLIFE

REGIONAL SETTING

Wildlife habitats in the project area are typical of Gunnison County and southwestern Colorado above 7,500 feet. Throughout this region, large expanses of shrublands, montane forests, and alpine-subalpine habitats are relatively unmodified, whereas the major valley bottoms are used for native hay production and cattle pasturing. The pasture areas form agricultural wildlife habitat. Cattle also graze on the shrublands, meadows, and grasslands throughout the region.

The common big game species in the region are elk, mule deer, bighorn sheep, and black bear. Mountain lions are seen infrequently. The game birds in the area are sage grouse, blue grouse, and, locally, white-tailed ptarmigan and waterfowl. Songbird diversity is greatest from late Spring through early Fall. During Winter, most nongame birds migrate south. Elk and mule deer move to winter ranges on southern exposures at elevations below about 9,000 feet.

Detailed wildlife information can be found in the following reports, which are incorporated by reference: Stoecker-Keammerer (1980), and Colorado Cooperative Wildlife Research Unit (1979-1981).

Habitat use by the inventoried species is described in Appendix I.

MINE AREAS

Wildlife species on Mt. Emmons are typical of those occupying similar habitat throughout the region. White-tailed ptarmigan occur in Red Lady Basin, and blue grouse occur in most of the habitats on Mt. Emmons. The area is summer range for mule deer (Odocoileus hemionus) and to a lesser extent elk (Cervus canadensis).

MILL AREAS

Alkali Basin - Wildlife habitat in the Alkali Basin area is predominantly big sagebrush shrubland. Aspen woodlands extend into the basin from the north end of Flat top and from the southeast end of Red Mountain (Figure 3-2). Riparian willow thickets occur along Alkali Creek and also occur in moist draws on the south slopes of Red Mountain. As a result of seasonal flooding and irrigation, some wetland habitat occurs adjacent to Alkali Creek. Wildlife species occupying these habitats are typical of similar areas in the region.

Six to eight beaver ponds occur on Alkali Creek in the tailing disposal area. Signs of beaver activity were observed during the 1979 field season (Stoecker-Keammerer, 1980) but none were found during the 1980 field season (CDM, 1981b). The beaver ponds studied in 1980 were shallow due to siltation. The ponds' banks and dams supported 3-foot willow shoots. Most likely, the half-mile distance between the ponds and the nearest aspen contributes to the marginal nature of beaver habitat on Alkali Creek.

Mallards have been observed in Alkali Basin during Summer and Fall. An evaluation of the potential of Alkali Basin as a waterfowl habitat was made during 1980 (CDM, 1981b). Although adequate nesting cover is present, the absence of extensive open water for brood habitat, resting, and escape, and the lack of aquatic vegetation for food, limits the value of Alkali Basin for waterfowl breeding. Due to these limitations, Alkali Basin currently provides breeding habitat for only two to three pairs of ducks.

Sage grouse, which breed on leks on the lower west-southwest slopes of Flat Top, range throughout Alkali Basin during the Summer and Fall. Blue grouse can be found in the aspen on Red Mountain and Flat Top in the Spring, Summer, and Fall. Juvenile blue grouse congregate in more open sagebrush areas in the late Summer and early Fall.

Although Alkali Basin is not big game winter range, elk and mule deer migrate through the east end of the basin and along the west ridge of the basin in May and November-December. Narrow aspen woodlands (referred to as 'fingers') extending from the southeast end of Red Mountain into the Basin are used by deer and elk as a primary movement route (Figure 3-2).

A major elk calving area was identified extending roughly from the east slopes of Red Mountain to low on the west slopes of Red Mountain.

Nongame birds and mammals were found to be intermediate in diversity and abundance in Alkali Basin compared to other habitats within the Project area.

Carbon Creek - This area lies in montane forest habitat. Wildlife populations and species diversity are similar to those found in the mine site areas, and are typical of similar habitats in the region. This area contains willow thickets, wetlands, and active beaver colonies. The site supports transient populations of waterfowl. Blue grouse are also present. Mule deer and elk use the area as summer range, while the principal elk calving areas are further south. Elk tend to congregate in the Gibson Ridge-Whetstone Mountain area later in the year.

Chance Gulch - Wildlife habitat in Chance Gulch is primarily big sagebrush shrubland with a poorly developed herbaceous understory. The lack of herbaceous vegetation and trees limits the diversity of wildlife species. Hay meadows in the floodplain of Tomichi Creek are characterized by meander scars, grass meadows, and localized stands of sedges (Juncus spp.). Willows occur in narrow strips scattered along the more prominent oxbow meander scars in the floodplain.

According to the Colorado Division of Wildlife (CDOW), 11 sage grouse leks lie within 1.9 miles of the Chance Gulch site. This is the highest known concentration of leks in Gunnison Valley. Sage grouse normally nest within 1.9 miles of the lek (Gill, 1965; Wallestad and Pyrah, 1974). The site, therefore, represents potential nesting ground for grouse from each of these 11 leks. Sage grouse are year-round residents and may winter in those portions of Chanch Gulch which stay relatively snow-free.

Chance Gulch is not an important big game winter range. In severe winters, mule deer and elk are restricted to south-facing slopes north of U.S. Highway 50 and to the hay meadows immediately south of the highway. Use of the sagebrush shrubland south of the highway is notably light, probably due to the scarcity of tall shrubs and trees which form escape cover.

SENSITIVE AREAS

Four areas of special significance to wildlife were identified: (1) the south-facing slope of Flat Top, (2) the Almont Triangle, (3) the cottonwood grove north of Almont, and (4) the sage grouse leks near Ohio Creek and in Chance Gulch. The south-facing slope of Flat Top and the Almont Triangle, between the Taylor and East Rivers, provide winter range for elk and mule deer. The cottonwood grove north of Almont is wintering habitat for two to three bald eagles. The sage grouse breeding areas near Ohio Creek are the primary strutting grounds in the Flat Top area, while those in Chance Gulch represent the highest known concentration in the Gunnison Valley.

THREATENED AND ENDANGERED SPECIES

Threatened or endangered species identified within the project area include the bald eagle (Haliaeetus leucocephalus), which is a federally listed endangered species, and the Greater sandhill crane (Grus canadensis tabida), which is a State-listed endangered subspecies when breeding in Colorado. Two to three bald eagles are repeatedly observed from November through February in the cottonwood grove between Almont and the Roaring Judy Fish Hatchery. "This area has long been known as wintering habitat for bald eagles. Two flocks of Greater sandhill cranes were observed during the spring migration of 1979. In April 1980, nine sandhill cranes were observed in a hay meadow in Ohio Creek. A whooping crane (Grus americanus), fostered by sandhill cranes at Gray's Lake, Idaho, was observed in the spring of 1980 with a flock of sandhill cranes in a pasture in lower Ohio Creek." (AMAX, 1981a; and Forest Service, 1981d)

BIG GAME ROAD MORTALITY

Most recorded road kills in the area occur along U.S. Highway 50 east and west of Gunnison. During the 1976-1979 period, CDOW records indicate that 247 animals were killed. Along Colorado 135 between Gunnison and the Cement Creek road south of Crested Butte, CDOW records indicate 16 road kills during the same period. Along Colorado 114 southeast of Gunnison, 12 road kills were reported. Only one kill was reported on the Ohio Creek road north of Gunnison.

AQUATIC ECOLOGY

Detailed information concerning aquatic ecology in the project area can be found in the following reports, which are incorporated by reference: CDM (1980v-y); AMAX (1981a).

MINE AREAS

Coal Creek - Coal Creek flows south from its headwaters in Independence Basin through the settlement of Irwin and then turns to the east toward the Town of Crested Butte. Near Kebler Pass, the creek meanders through a willow-covered subalpine meadow containing a series of beaver ponds. Populations of brook trout (Salvelinus fontinalis) collected in this area ranged from 1,420 to 2,000 fish per mile. The lower numbers were found just above the Keystone Mine outfall. Over 90 percent of these were less than 8 inches long.

Upper Coal Creek supports a diverse community of benthic invertebrates and a dense growth of attached algae.

Acidic metals-rich drainage from the Keystone Mine has eliminated the fishery in lower Coal Creek for several years. Fish surveys in 1978 failed to collect any fish in that section. The June 1981 startup of a heavy metals treatment plant will bring this pollution under control and improve the aquatic environment. A fishery should become reestablished.

Slate River - The Slate River upstream of its confluence with Coal Creek flows through a wide alluvial valley. Its gradient is approximately 0.2 percent and the stream channel meanders across a grass-, sedge-, and willow-covered floodplain. The substrate in this area is predominantly composed of flat shale gravel and rubble. Due to its gentle gradient, the habitat of the Slate River is dominated by 2-4 foot deep pools.

In Fall 1979, the trout population above the Coal Creek confluence was estimated at 4,660 fish per mile. While brook trout predominated, study teams also collected brown (Salmo trutta), cutthroat (Salmo clarkii) and white suckers (Catostomus commersoni).

The density and diversity of benthic invertebrates collected at the above sample station were variable for the 2 year period of study.

MILL AREAS

Alkali Creek - Alkali Creek does not have sufficient flow to support a fish population. Compared with the other stations in the study area, a relatively dense and diverse community of benthic invertebrates was collected in 1979. Chironomidae (midges) were the most common group of organisms in riffle and pool samples.

Although observations and shocking studies were conducted, no fish were captured or observed in either Alkali Creek or Big Alkali Lake on the slope of Red Mountain. It is doubtful that a stable fish population could be supported in Alkali Basin.

Carbon Creek - Carbon Creek drains the south face of Mt. Axtell and is less than 12 feet wide in most places. Lower Carbon Creek contains several 2-5 foot deep pools that provide cover for trout, especially during low flow periods in the fall and winter.

The lower reaches of Carbon Creek were estimated to support trout populations (predominantly brook, with about one percent brown) of 2,550 per mile. About 37 percent of the brook trout were over 6 inches long.

Of 14 stream sample stations in the project area, Carbon Creek was intermediate in its benthic macroinvertebrate diversity.

Chance Gulch-Tomichi Creek - Chance Gulch is an ephemeral drainage, and thus no aquatic ecology samples could be collected. Chance Gulch drains into Tomichi Creek, a major tributary in the upper Gunnison River watershed. Tomichi Creek flows west from its headwaters near Monarch Pass to its confluence with the Gunnison River south of Gunnison. The gradient of Tomichi Creek is less than 1 percent, and the stream channel meanders through hayfields and pastures. The banks of Tomichi Creek are lined with grasses and shrubs. The substrate in the riffles is rubble and coarse gravel; in pools the substrate is covered with silt and sediment.

In Fall 1980, the Tomichi Creek trout population (all brown trout) was estimated at 634 per mile. About 87 percent of the trout were over 6 inches long. An additional 5,724 nongame fish per mile was estimated. The nongame fish captured were longnose dace (Rhinichthys cataractae), white sucker (Catostomus commersoni), longnose sucker (Catostomus catostomus) and fathead minnows (Pimephales promelas).

ENERGY

REGIONAL SETTING

The Gunnison Basin is a high-elevation rural environment. The area is recognized nationally for its severe winter temperatures, which drop to 45° below zero. The area also receives considerable solar insolation.

Average annual heating degree days range from 10,530 in Gunnison to 11,200 in Crested Butte, which means that considerable energy is needed for heating.

In the early 1970's, Gunnison County was one of only four Colorado counties that produced more energy than it consumed. This was primarily because of coal and hydroelectric production. (Forest Service, 1981b)

ENERGY CONSUMPTION

A Forest Service energy assessment compiled data on energy consumption in Gunnison County (Forest Service, 1981b). The results of this assessment are shown in Table 3-2 and discussed below.

Electricity - Two utilities sell all of the electricity used in the Gunnison Basin. The City of Gunnison sells electricity within the corporate limits and to a limited area outside. Gunnison County Electric Association (GCEA) services all other areas of the Gunnison Basin. There was a total of 76,633,113 Kwh sold in the Gunnison Basin in 1978. While service areas and population estimate boundaries do not match perfectly, they are reasonably accurate to develop per capita consumption data. Per capita consumption of electricity in 1978 was approximately 6,910 Kwh. Over the past five years electricity consumption per capita increased at a rate of 1.5 percent per year. This compares with Colorado trends

TABLE 3-2 REGIONAL COMPARISON OF PER CAPITA ENERGY CONSUMPTION (1977 - 1978)

	Physical Units		Btu's (Millions)			
	Colorado	Gunnison Basin	Colorado		Gunnison Basin	
Energy Type	Average Annual Consumption	Average Annual Consumption	Average Annual Consumption	% of Total	Average Annual Consumption	% of Total
Electricity	7100 Kwh *	6910 Kwh	(26.15)		23.58	12.2
Natural Gas	109 MCF *	46 MCF	96.99	30.8	45.76	23.8
Gasoline	595 gal.	516 gal.	71.40	22.6	65.84	34.2
LPG	75 gal. *	131 gal.	6.89	2.2	12.01	6.2
Fuel Oil	56 gal. *	40 gal.	8.33	2.6	5.38	2.8
Coal	8330 lbs. *	713 lbs. *	86.03	27.3	8.11	4.2
Diesel	156 gal. *	N/A	21.65	6.9	21.65**	11.2
Wood or Other	N/A	0.6 cords	24.24	7.7	10.08	5.2
		TOTAL	315.53	100.0	192.41	100.0

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* 1977 Data

** Assumed equal to State consumption rate which are increasing at a rate of 4.5 percent per year.

Gasoline - There were 5,719,000 gallons of gasoline sold in Gunnison County in 1978 (Brown, et. al., 1980).

This represents annual per capita sales of 516 gallons. Between 1974 and 1978, per capita consumption has declined at an average rate of 4.7 percent per year. This constrasts with Colorado's per capita consumption trend which, during the same period, increased at a rate of 3.5 percent per year.

Natural Gas - One utility services the Gunnison Basin. While there are a few hookups in rural areas, the bulk of its service is confined to Gunnison city limits. Consumption history was influenced by a hookup moratorium between (approximately) September 1974 and September 1978 (Peoples Natural Gas, 1975 - 1979). Between 1976 and 1979, per capita consumption in Gunnison County declined at a rate of 5.6 percent per year. This compares with Colorado's per capita consumption which is declining at a rate of 7.48 percent per year.

Liquid Natural Gas (LNG) - Mid-distillates-heating oil-butane-propane - There are several retailers selling LNG products in the Gunnison Basin. One distributor services Crested Butte with an underground pipe distribution system for propane. Estimated 1977 average annual consumption per capita was 131 gallons of LPG and 40 gallons of oil. No historical consumption trends could be determined for these fuels.

Wood - Firewood consumption estimates indicate that 6,180 cords of firewood were consumed in Gunnison County in 1978. No historical trend could be determined.

Coal - Coal is currently a minor fuel in Gunnison County. Less than two percent of the respondents in the Gunnison County Survey indicated they heated with coal (CJRP, 1979). One reference cited coal consumption in Gunnison County for 1977 at 3,654 tons (Brown, et. al., 1980). This represents an annual per capita consumption of 713 pounds. No historical trends could be determined.

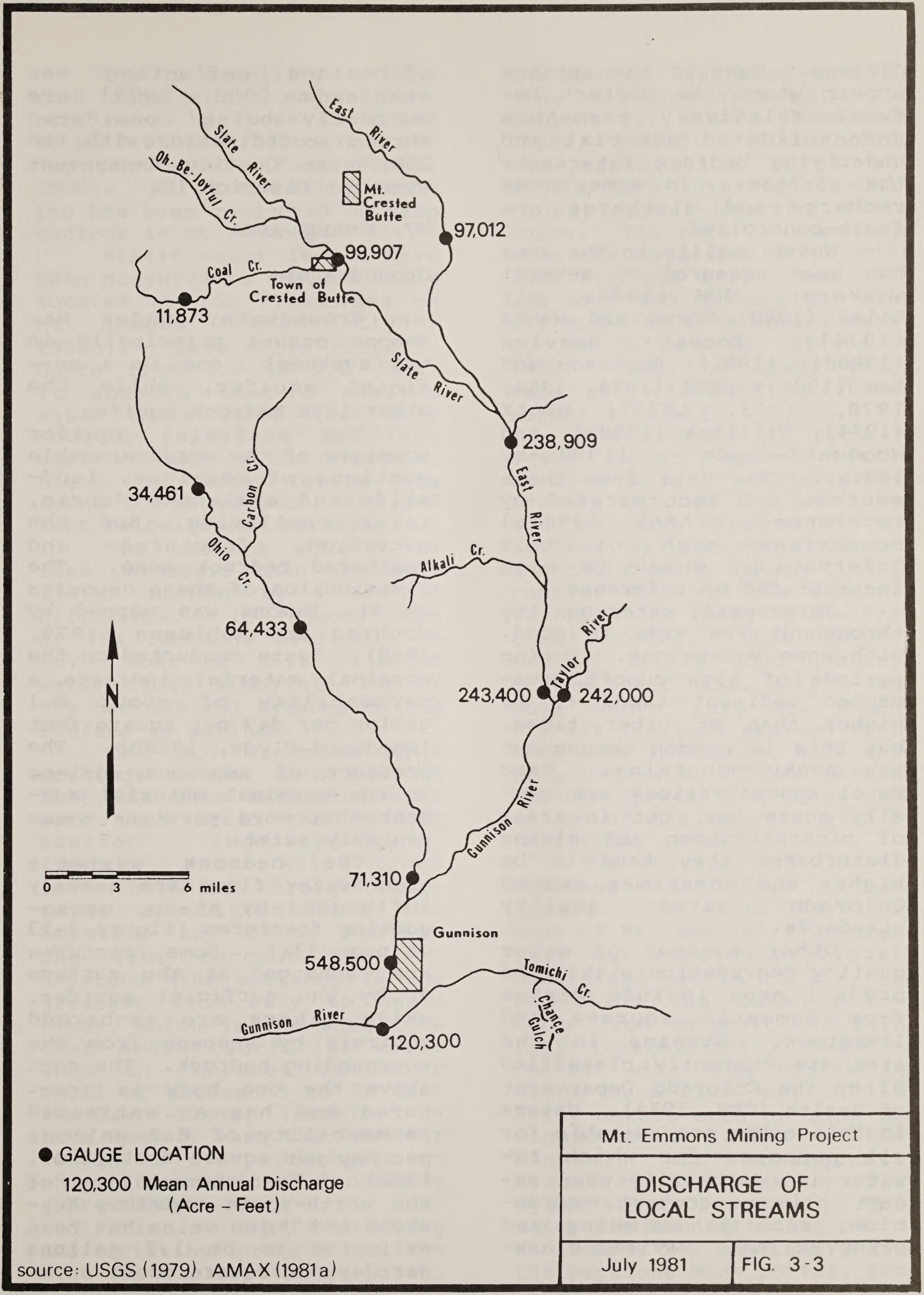
WATER

REGIONAL SETTING

The mine and mill sites are located in the Gunnison River basin in northern Gunnison County. The area is characterized by relatively steep terrain with an elevation range about 5,400 feet. The highest point in the area is Mount Owen in the Ruby Range at 13,058 feet elevation while the elevation of the Gunnison River at the city of Gunnison is 7,652 feet.

The project area is dissected by numerous streams with flows ranging from intermittent trickles to annual discharges of 700 cubic feet per second. Major streams in the area and their mean annual discharges are shown in Figure 3-3. As with most streams throughout the central Rocky Mountains, snowmelt contributes the bulk of total annual runoff. Most of the runoff occurs during May and June when the snowpack melts.

Groundwater in the project area occurs under both water table and artesian con-


East River
Slate River
Oh-Be-Joyful Cr.
Mt. Crested Butte
97,012
99,907
Coal Cr.
Town of Crested Butte
11,873
Slate River
238,909
East River
Carbon Cr.
34,461
Ohio Cr.
Alkali Cr.
64,433
Taylor River
243,400
242,000
N
Gunnison River
0
3
6 miles
71,310
Gunnison
548,500
Tomichi Cr.
Chance Gulch
Gunnison River
120,300
● GAUGE LOCATION
120,300 Mean Annual Discharge (Acre - Feet)

source: USGS (1979) AMAX (1981a)

Mt. Emmons Mining Project

DISCHARGE OF LOCAL STREAMS

July 1981

FIG. 3-3

ditions. Many of the springs appear where the contact between relatively permeable unconsolidated material and underlying bedrock intersects the surface. In some areas recharge and discharge are fault-controlled.

Water quality in the area has been measured by several workers: CDM (1980a, v); Giles (1980) Moran and Wentz (1974); Forest Service (1980d); (1981); Robinson and Dea (1981); USGS (1954, 1964, 1970, 1973, 1977); Wentz (1974); Williams (1980a), and Woodward-Clyde (1980a-b, 1981a). The data from these sources are incorporated by reference. AMAX (1981a) summarizes much of this information, which is also incorporated by reference.

In general, water quality throughout the area is good, with some exceptions. During periods of high runoff, suspended sediment tends to be higher than at other times, but this is common throughout the Rocky Mountains. Base metal concentrations are usually quite low, but in areas of mineralization and mining disturbance they tend to be higher and sometimes exceed Colorado water quality standards.

Other sources of water quality degradation within the project area include wastes from domestic sources and livestock. Streams in the area are currently classified B1 by the Colorado Department of Health (CDH, 1974). Waters in this class are suitable for all purposes for which raw water is customarily used except primary contact recreation, such as swimming and water skiing. Revised classifications reflecting new standards (CDH, 1979) are currently being considered through coordination with the 208 Water Quality Management Plan for District 10.

MT. EMMONS AREA

Groundwater

Groundwater under Mt. Emmons occurs principally in two systems: one is a surficial aquifer, while the other is a bedrock aquifer.

The surficial aquifer consists of the more permeable portions of moraines, landslide and avalanche debris, talus, colluvium, and the outermost fractured and weathered bedrock zone. The distribution of these deposits on Mt. Emmons was mapped by Cochran and Robinson (1979, 1980). Tests conducted on the morainal material indicate a permeability of about 0.1 gallon per day per square foot (Woodward-Clyde, 1980b). The presence of numerous springs in the morainal material suggest that more pervious zones probably exist.

The bedrock system's groundwater flows are heavily influenced by steep, cross-cutting fractures (Figure 3-13 on page 92a). Some fractures are recharged at the surface or by the surficial aquifer, while others are recharged entirely by seepage from the surrounding bedrock. The rock above the ore body is fractured and has an estimated permeability of 0.2 gallons per day per square foot (Snow, 1980). The permeability of the north-south trending Keystone and Union veins has been estimated to be 1.2 gallons per day per square foot.

The permeability of the rock outside the major fracture zones has been estimated to be 0.02 to 0.002 gallon per day per square foot (Snow, 1980). No permeability testing has been conducted on deep bedrock in Mt. Emmons.

Static water levels have been measured in shallow wells located at low elevations on Mt. Emmons (Woodward-Clyde, 1980b). These wells range in depth from 4.5 to 250 feet. It appears that a shallow water table 20-50 feet deep roughly parallels the land surface lower on the mountain. Higher up, water levels were found to be as much as 1,000 feet below ground surface.

The bedrock aquifer is less permeable than the surficial aquifer by a tenfold difference. It rejects much of the recharge available to it. Most of this rejected water flows along the top of the bedrock and returns to the surface as springs.

The old Keystone Mine workings extend into bedrock that was once saturated with water and drain the bedrock aquifer (Woodward-Clyde, 1980b). Water still flows into the mine through fractures associated with the Keystone and Union Faults. The flow through the old Keystone Mine workings is the greatest from July to September, which is the same time that nearby surficial wells show an increase in water level of between 5 to 30 feet (Woodward-Clyde, 1980b). By late Summer, when the snowmelt season is over, discharge to the old workings decreases appreciably.

Prior to AMAX's drilling and drifting program in the mine for exploration purposes, the average discharge from the mine was approximately 175 gallons per minute (Woodward-Clyde, 1980b). Since 1978, new exploration holes and drifts have intercepted additional water-bearing fractures. The rate of discharge from the Keystone Mine during late May and early June 1979 was over 400 gallons per minute compared with approximately 300 gallons per minute in 1980. Both of these years were characterized by above-normal snowfall.

The quality of groundwater in Mt. Emmons varies considerably. Water that travels through the surficial aquifer and appears at the surface as springs does not generally spend enough time in contact with soluble minerals to pick up many dissolved constituents. These waters are of fairly good quality. On the other hand, waters that move deeper into Mt. Emmons via its fracture systems spend more time in contact with soluble minerals. Those passing through pyrite-rich zones tend to be of the poorest quality (Williams, 1980a).

The workings of the old Keystone Mine appear to have lowered the water level in many of Mt. Emmons' fractures. This has exposed previously unoxidized pyrite to air, and oxidation has taken place. Water from snowmelt and rainfall intermittently comes in contact with this pyrite and turns iron-rich and acidic. Heavy metals such as zinc and manganese in other sulfide minerals are subsequently dissolved and poor quality groundwater results. This water has been draining out of Mt. Emmons for many years from the Keystone Mine portal, from springs in Redwell Basin, and from springs that feed into several iron bogs, including the Mt. Emmons Iron Bog.

Surface Water

Mt. Emmons is bounded by Coal Creek on the south, Oh-Be-Joyful Creek on the north, and the Slate River on the east (Figure 3-3). Major tributaries to Coal Creek include Elk Creek and Splains Gulch. Some of the flow in Coal Creek comes from a diversion out of Lake Irwin, which is at the headwaters of Ruby Anthracite Creek. This diverted water is part of the Town of Crested Butte's water supply. The Town's intake is shown in Figure C-11 on page 340.

The water quality of streams in the Mt. Emmons area is influenced by the seasons, the weather, the geology of individual watersheds, and human activities. When snowmelt and rainfall lead to increased streamflows, sediment and turbidity levels rise. This is a typical pattern.

The chemical aspects of water quality in both Coal and Oh-Be-Joyful Creeks are influenced by acid seepage out of Mt. Emmons. Both creeks are of reasonably good quality near their headwaters, but as their lower reaches enter the general zone of seepage (the confluence of Redwell Basin on Oh-Be-Joyful, and of Elk Creek on Coal Creek) they become more acidic and higher in heavy metals.

The Keystone Mine has been a major source of acid and high heavy metals concentrations for years. Water from the mine enters Coal Creek just below the Town of Crested Butte's water intake. This water has kept the lower reaches of Coal Creek from being a viable fishery. Anomalously high heavy metals concentrations have been measured as far downstream as the East River. The Slate River is affected by the Town of Crested Butte's municipal waste water treatment plant. Average concentrations of total phosphate and ammonia nitrogen are higher there than at other points of measurement further upstream. Additional ammonia is introduced into the Slate and East Rivers by the treatment plants for Mt. Crested Butte and Crested Butte South.

ALKALI CREEK AREA

Groundwater

The bedrock underlying the tailing disposal area is Mancos Shale (Figure 3-13 on page 92a). It is more than 3,000 feet thick, very uniform, and not marked by significant structural features. No major aquifers have been identified in it. The Mancos Shale bedrock has an average permeability of .024 gallons per day per square foot (CDM, 1980a).

The hydrogeologic units identified in Alkali Basin are alluvial, colluvial, and slope failure deposits, lake deposits, and bedrock. The alluvium is the most permeable unit, but is not a major hydrogeologic unit. Analysis of data from one test performed in the alluvium indicates a permeability of 10.5 gallons per day per square foot (CDM, 1980a).

The colluvial and slope failure deposits hold large amounts of water in temporary storage, often under perched conditions. In some areas, they may transmit water to the surface in the form of springs and seeps.

Lake deposits cover most of the valley bottom in the western portion of Alkali Basin. These deposits are saturated, but their apparent low permeability indicates that water movement occurs only at low velocities and in small quantities.

Groundwater generally moves downward through the surficial units until it reaches a surface of relatively unweathered and unfractured shale. Below this surface, vertical permeability is significantly reduced, and only a small amount of water is able to continue moving downward. Most water probably moves laterally along this surface through the broken and weathered zone. The Mancos Shale dips generally to the northwest and therefore ground water movement through it should also be in that direction at a very slow rate. The northwestward dip should tend to prevent eastward groundwater movement through bedrock into the East River area.

The results of chemical analyses on groundwater samples generally show less than 1,000 milligrams per liter total dissolved solids. The field pH of most samples was about 6. Additional data are available in CDM (1980a).

Surface Water

The Alkali Creek watershed, above the mill water reservoir, covers approximately 7 square miles and lies between Red Mountain on the north and Flat Top on the south. Alkali Creek flows to the east and is intercepted by irrigation canals before emptying into the East River.

Computer simulation of basin hydrology indicates that the probability of a major flood in Alkali Basin is small, and that flows can be controlled by conventional engineering methods (AMAX, 1981a).

The surface waters of Alkali Basin have much higher alkalinity and hardness levels than other stations in the overall study area (CDM, 1980v). Observed water quality is less than that for other tributary drainages due to the presence of livestock, the decomposition of Mancos Shale, and the erosion of lake bed sediments.

Although Alkali Creek carries much higher dissolved solids concentrations than the East River, the Creek's limited flow results in little net change in water quality in the East River.

Water quality data were also collected at the spring used for the Roaring Judy Fish Hatchery. Water from this spring has higher alkalinity and hardness levels than at sample stations along Alkali Creek. Samples from this spring show less seasonal variation than do the surface water samples. Metal concentrations are generally lower. An elevated zinc concentration of 0.15 mg/l was reported for the September 1978 sampling period.

CARBON CREEK AREA

Groundwater

Large deposits of glacial and mass movement debris overlie the area's bedrock. Water seeps through those deposits and enters underlying sedimentry aquifers (Williams, 1980b). This is particularly true of the talus and rock glacier deposits that mantle the north and east sides of Carbon Peak. These are expected to have high permeabilities, but no tests have been run.

Ground water moves downvalley in the surface deposits. In the bedrock aquifers, groundwater movement directions are not known because of structural complications introduced by the Carbon Peak intrusive and by local faulting.

Surface Water

Ohio Creek flows south from Ohio Pass and drains a rich alluvial valley. Hayfields cover much of the valley floor. Although several abandoned coal mines are present in the Ohio Creek drainage, no evidence of reduced water quality is apparent.

A sample station on Ohio Creek, located approximately 0.5 mile upstream of the Carbon Creek confluence, shows good water quality, although signs of nutrient enrichment are present. The probable source of this nutrient input is livestock feces, although septic tank systems may also be contributors.

Carbon Creek drains the south face of Mt. Axtell and flows into Ohio Creek. This creek, which is less than 12 feet wide in most places, flows through a broad valley used for pasturing livestock and producing hay. Coal mining has occurred in the upper portions of this drainage. A water quality station located approximately 0.25 mile upstream from the Ohio Creek confluence shows good water quality. Aluminum and iron concentrations are low. The higher concentrations of these two metals in Ohio Creek are probably due to correspondingly higher suspended solids concentrations.

Additional data are available in AMAX (1981a, Table 4.3-13).

CHANCE GULCH AREA

Groundwater

The gravels and volcanic tuffs exposed in the Chance Gulch area appear to be highly permeable. Soil mapping indicates generally high infiltration rates at the surface (SCS, 1975). Water is thus able to move downward easily until it reaches the underlying Precambrian rocks (Williams, 1980c). The surface of the Precambrian basement dips gently to the north, and is probably irregular and fractured. Groundwater movement along this surface undoubtedly feeds into the alluvial gravels of Tomichi Creek after following rather complex paths of movement.

Small springs are present in the center and at the western side of the basin. Most of the springs are associated with the Precambrian basement. Some of these springs are listed by the BLM as within

Public Water Reserve No. 107. Two areas with adjudicated water rights are in the vicinity.

Surface Water

Because Chance Gulch has only ephemeral flow, no water quality stations were established in it. Stations were established on Tomichi Creek above and below the confluence with Chance Gulch. Data from these stations are contained in AMAX (1981a, Table 4.3-13).

AIR

Detailed information on meteorology and air quality in the project area can be found in the "1979 Baseline Meteorology and Air Quality Report for the Mt. Emmons Project" (CDM, 1980s and 1980t, Appendix D), which is incorporated by reference. The following is a brief summary of that report.

METEOROLOGY

A variety of local temperature and precipitation regimes occurring within the Project area are due to the wide variation in topography. On the high mountain slopes, daily temperatures average less than 32°F year-round. During clear Winter days, the drainage of air off snow-covered mountain peaks causes intense temperature inversions and cold nighttime temperatures. The record low temperature in Colorado is -60°F at Taylor Park Dam (elevation 9,200 feet) northeast of the Project area on February 1, 1951.

Summer daytime temperatures in the mountains are generally cool, averaging between 16-69°F, while the valley locations experience 70-80°F. On occasion, temperatures at lower elevations may reach 95°F when slow-moving high pressure systems dominate. Summer nights are cool (41-50°F) due to the rapid loss of heat through the relatively thin atmosphere at these high elevations.

As with temperature, the precipitation pattern in the project area is dependent upon topography. The mountain slopes experience the most precipitation in Winter, all in the form of snow. Snowfall greater than 12 inches is common for the mountain slopes in Winter. The lower elevations, including the City of Gunnison, receive one-third less snowfall than the higher mountains. The range of total annual snowfall for the region is 60-200 inches, equivalent to 5-17 inches of rain.

Summer rain storms result from moisture intrusion from the Gulf of Mexico. Individual showers usually range from 0.1-0.5 inch. These showers normally contribute about 6 inches to the precipitation total at the Town of Crested Butte, while the City of Gunnison receives about 4 inches during June, July, and August. Fall months (September through November) experience the least precipitation (about two-thirds the summertime totals) mostly in the form of thundershowers and occasional weak frontal activity.

The regional air-flow pattern over the Project area generally moves from west to east. Local terrain tends to deflect low-level winds.

During the Summer months, rising masses of warm air often evolve into thunderhead systems thousands of feet high. During the Winter months less warming occurs and the thermal breakup is considerably less. It is common for a cold air layer to remain in the valley bottoms for several days at a time.

AIR QUALITY

The dominant air pollutant in the project area is particulate matter, which comes from roads, chimneys, and vehicles.

In Gunnison and in the Town of Crested Butte, where people are concentrated, particulate levels can become quite high. Throughout the rest of the Project area, particulate levels are generally much lower. Figure 3-4 shows particulate concentrations in the Project area which were measured during 1979. Gunnison's particulate levels are highest during the winter months. In Crested Butte they are high in both Winter and Summer. Chimney smoke (Winter) and street dust (Winter and Summer) seem to be the usual sources.

Other pollutants emitted locally include sulfur dioxide (SO_2), carbon monoxide (CO), and hydrocarbons. Limited monitoring was done by CDM for these in 1979; the results indicate that concentrations meet Colorado Department of Health standards.

Recent work in the Gothic area indicates that acid precipitation is occurring. It is believed to be caused by major fossil fuel-burning facilities in other parts of the United States.

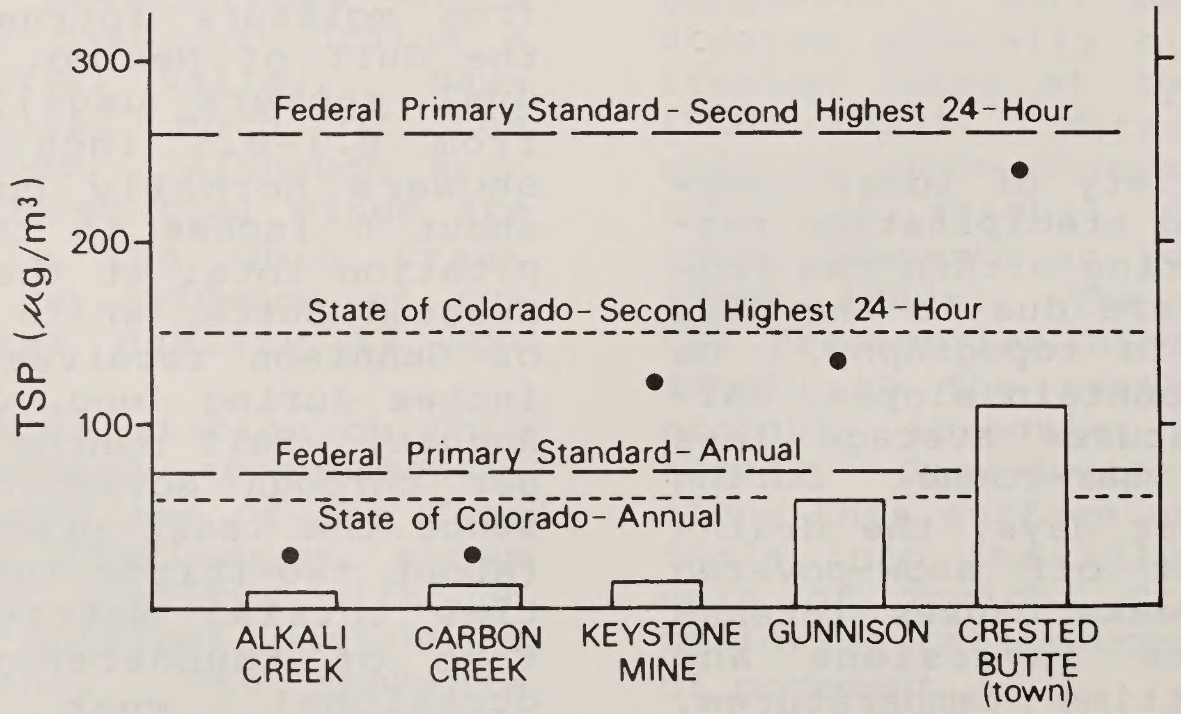


Figure: 3-4

PROJECT AREA TSP (Bars = average annual TSP. Dots = second highest.)

source: CDM (1980s)

NOISE

With the exception of human activities, the Project area is generally quiet and the sounds of nature prevail. Figure 3-5 below indicates that only a few of the locations monitored experience the noise of typical urban settings.

Further details on the Project area's noise environment can be found in SAI (1980a, 1980b), which are incorporated by reference.

CULTURAL RESOURCES

OVERVIEW

Little cultural resource information for the area existed prior to Project-related studies. Those archaeological sites which had been located were unspectacular lithic scatters. Historic sites resulting from late 19th Century mining activity are better known and include the Town of Crested Butte, which was designated a National Historic District on May 29, 1974. Summaries of the history of the study area may be found in Baker (1980), Lennon et. al. (1980), AMAX (1981a), Baker et. al. (1981) and Johnson (1981). The following is based on these sources.

ARCHAEOLOGICAL RESOURCES

Occupation of the study area appears to have begun

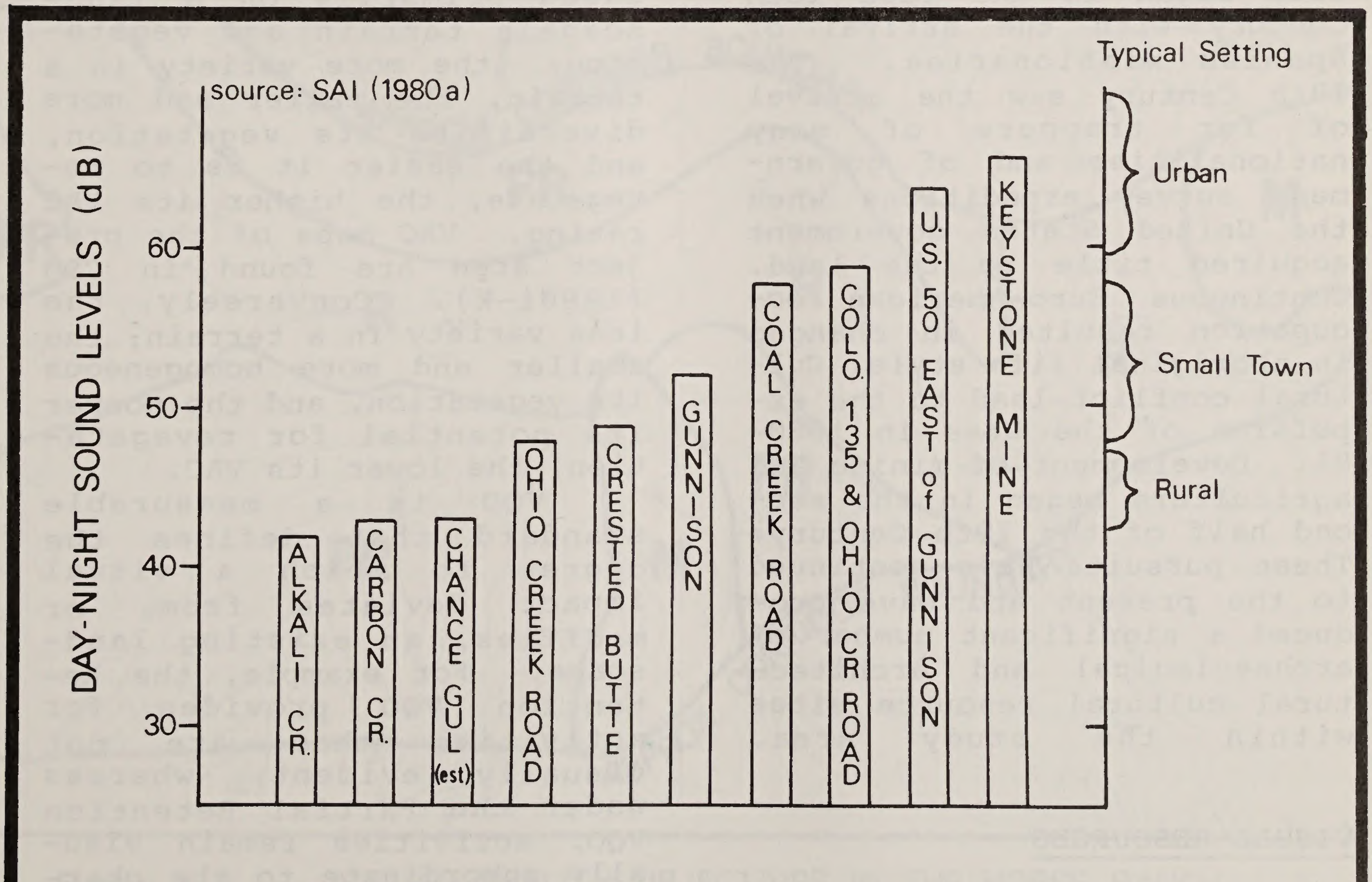


Figure: 3-5 AMBIENT NOISE LEVELS

approximately 11,000 years ago. From that time until the arrival of Euro-American settlers, the pattern of life was one of seasonal exploitation of plant, animal and mineral resources by small groups of nomadic hunter-gatherers. Study of the stone tools left by these people has resulted in a tentative sequence beginning with Clovis projectile points and ending in the artifacts of the Ute Indians, who were using the area at the time of first Euro-American contact. Many sites resulting from this aboriginal use are located in the study area.

HISTORIC RESOURCES

Euro-American penetration of the greater Gunnison Basin area began in the late 18th Century with the arrival of Spanish missionaries. The 19th Century saw the arrival of fur trappers of many nationalities and of government survey expeditions when the United States government acquired title to the land. Continuous Euro-American occupation resulted in changes in aboriginal life style. Cultural conflict lead to the expulsion of the Utes in 1880-81. Development of mining and agriculture began in the second half of the 19th Century. These pursuits have continued to the present and have produced a significant number of archaeological and architectural cultural resource sites within the study area.

VISUAL RESOURCES

The Project area straddles a transition zone between classic rugged alpine terrain to the north and west, and gently rolling foothills to the south. The alpine terrain is characterized by considerable visual diversity due to its complicated topography and vegetation, while the foothills offer less. Descriptions of the visual resources in the Project area, both general and site-specific, are in AMAX (1981a, Section 4.5.5) and CDM (1980b-d, h-l), which are incorporated by reference.

Two important concepts underly the consideration of visual resources: visual absorption capacity (VAC) and visual quality objectives (VQO).

VAC is the ability of a landscape to absorb visual impacts and is rated as High, Intermediate, and Low. It is based primarily on a landscape's terrain and vegetation: the more variety in a terrain, the taller and more diversified its vegetation, and the easier it is to revegetate, the higher its VAC rating. VAC maps of the project area are found in CDM (1980i-k). Conversely, the less variety in a terrain, the smaller and more homogeneous its vegetation, and the poorer its potential for revegetation, the lower its VAC.

VQO is a measurable standard that defines the degree to which a visual impact deviates from, or modifies, an existing landscape. For example, the Retention VQO provides for activities that are not visually evident, whereas under the Partial Retention VQO, activities remain visually subordinate to the characteristic landscape. VQO's are established according to the variety contained in a landscape and its sensitivity to visual disturbances. The latter partly involves a relationship between the viewer and the landscape.

A full description of the VQO concept is in Forest Service (1974). CDM (1980l) mapped VQO's in the project area. The bulk of the terrain is classified as Retention and Partial Retention, with lesser amounts of Modification and Maximum Modification being present.

The Forest Service has also mapped VQO's, this work covering National Forest System lands in the Marcellina Mountain, Paonia Reservoir, Anthracite Range, and Mt. Axtell 7 1/2 minute Quadrangles. In general, this work shows slightly more lenient VQO's than CDM's work, primarily because CDM included backcountry viewpoints in its analysis while the Forest Service did not. This resulted in slightly more stringent VQO's. An exception to this general difference centers on the Kebler Pass road. In this area the Forest Service's VQO's are more stringent. The foreground (as seen from the road) was wider, according to the Forest Service.

Although the bulk of the project area is of sufficient visual quality to merit the Retention or Partial Retention

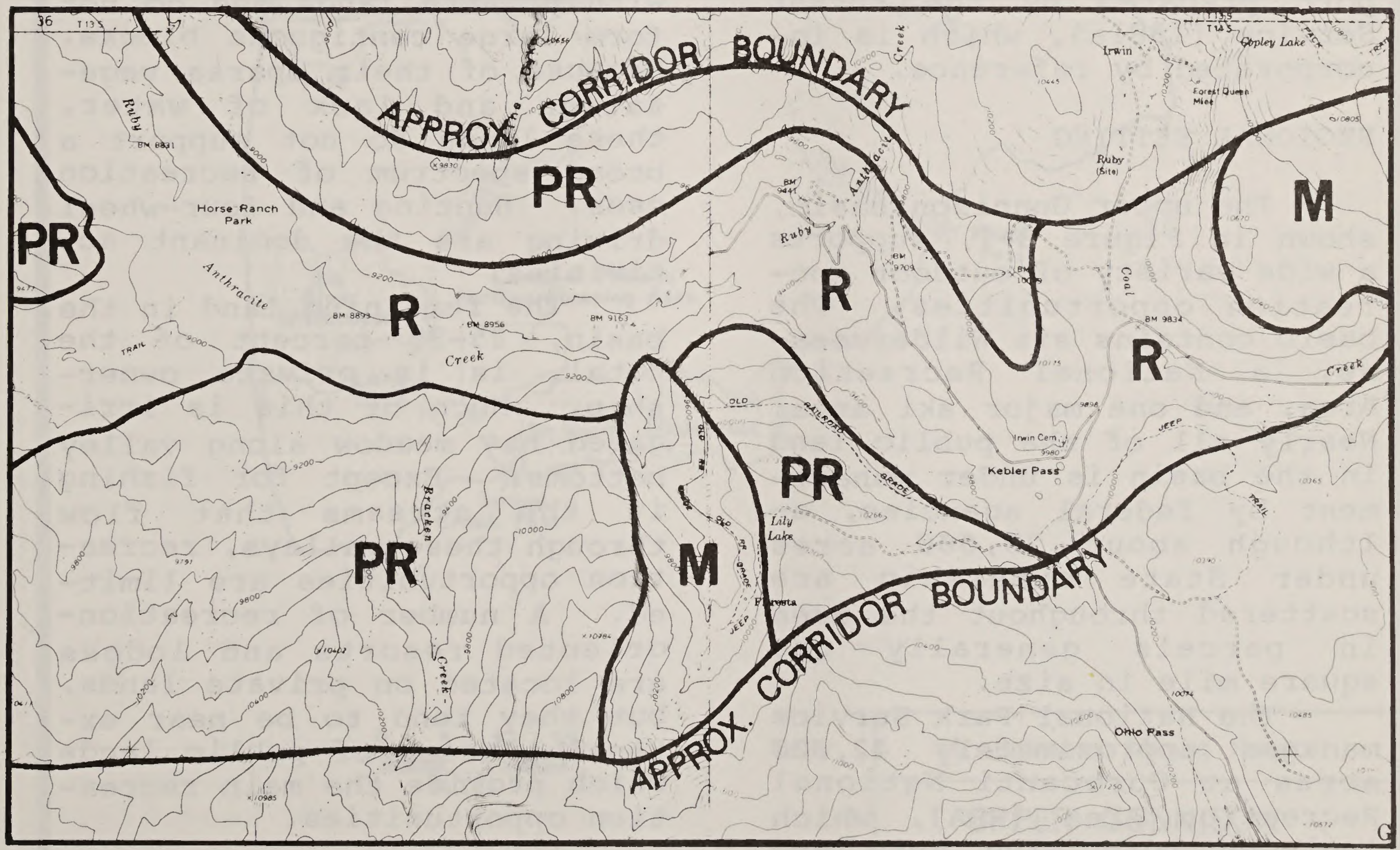

APPROX. CORRIDOR BOUNDARY
PR
PR
R
R
R
M
PR
PR
M
APPROX. CORRIDOR BOUNDARY
Horse Ranch Park
Ruby
Anthracite Creek
Creek
Bracken Creek
Irwin
Copley Lake
Forest Queen Mine
Ruby (Site)
Coal
Creek
Irwin Cem.
Kebler Pass
Lily Lake
Floresta
OLD RAILROAD GRADE
JEEP TRAIL
TRAIL
Ohio Pass

Figure: 3-6 VISUAL QUALITY OBJECTIVES IN THE HORSE RANCH PARK AREA (R= Retention, PR= Partial Retention, M= Modification)

source: U.S. Forest Service

VQO, one area in particular needs to be singled out. This is the Horse Ranch Park-Kebler Pass area shown in Figure 3-6. The visual resource there is highly sensitive because of the area's recreational use. Forest Service VQO's for this area are also shown in Figure 3-6.

OUTDOOR RECREATION

Two categories of recreation are discussed in this draft EIS: urban and outdoor. Urban recreation includes recreational activities associated with communities and is discussed on page 89 in this Chapter. Outdoor recreation is covered in this section as a summary of a technical report prepared by the Forest Service (1981a), which is incorporated by reference.

REGIONAL SETTING

The upper Gunnison basin, shown in Figure 3-7, supports a wide variety of outdoor recreation opportunities. The basin contains six Wildernesses, a National Recreation Area, and one major ski area. Nearly all of the public land in the basin is under management by federal agencies, although about 20,000 acres under State ownership are scattered throughout the area in parcels generally one square mile in size.

The National Park Service manages approximately 42,000 acres at Curecanti National Recreation Area (NRA), which includes both Blue Mesa and Morrow Point Reservoirs. Blue Mesa Reservoir is the largest body of water in Colorado. It is a popular place for water-oriented recreation activities. Morrow Point Reservoir, with limited access due to rugged surroundings, has fewer recreation opportunities but is still popular for day use, canoeing, fishing, and guided boat tours.

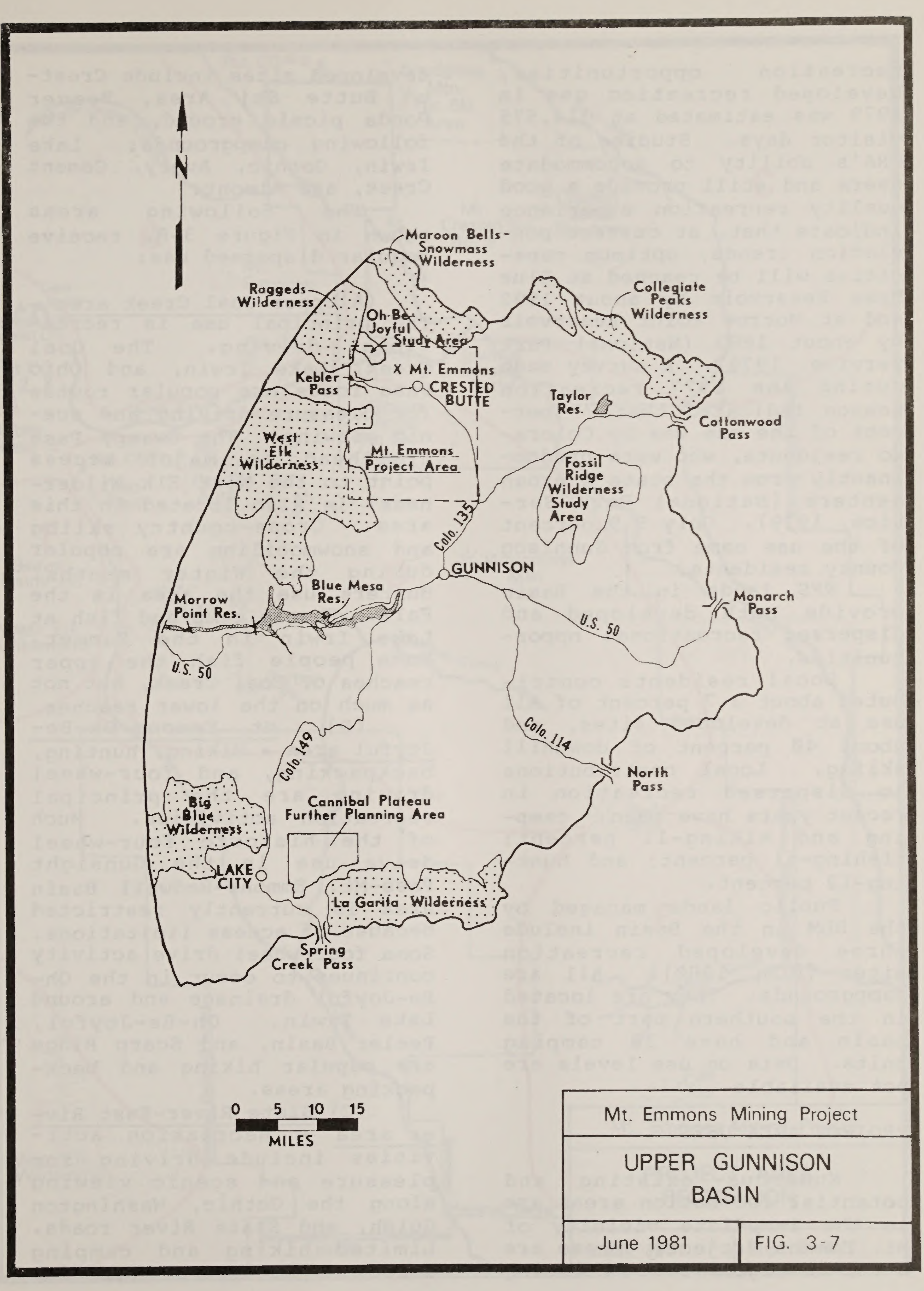
The Forest Service manages about 1.3 million acres in the upper Gunnison basin. The Taylor River and Cebolla Ranger Districts are responsible for managing these lands, which generally have a high value for developed and undeveloped recreation use because of their scenic quality, streams, lakes, and mountains.

The BLM manages about 410,000 acres of public lands in the central and southern portions of the basin. These lands are commonly intermixed with private lands and do not form large contiguous blocks. Because of their sparse vegetation and lack of water, these lands do not support a broad spectrum of recreation uses. Hunting and four-wheel driving are the dominant activities.

The remaining land in the basin, 25-30 percent of the total, is in private ownership. Much of this is irrigated hay meadow along valley bottoms. Except for fishing in the streams that flow through these valleys, recreation opportunities are limited. A number of recreation-oriented resorts and lodges are located on private lands, but they tend to be near extensive areas of public lands which provide the main recreation opportunities.

REGIONAL USES

Curecanti NRA provides developed and dispersed


N
Maroon Bells-Snowmass Wilderness
Raggeds Wilderness
Oh-Be-Joyful Study Area
Collegiate Peaks Wilderness
X Mt. Emmons
Kebler Pass
CRESTED BUTTE
Taylor Res.
Cottonwood Pass
West Elk Wilderness
Mt. Emmons Project Area
Fossil Ridge Wilderness Study Area
Colo. 135
GUNNISON
Blue Mesa Res.
Morrow Point Res.
Monarch Pass
U.S. 50
U.S. 50
Colo. 114
Colo. 149
North Pass
Big Blue Wilderness
Cannibal Plateau Further Planning Area
LAKE CITY
La Garita Wilderness
Spring Creek Pass
0 5 10 15
MILES

Mt. Emmons Mining Project

UPPER GUNNISON BASIN

June 1981

FIG. 3-7

recreation opportunities. Developed recreation use in 1979 was estimated at 314,575 visitor days. Studies of the NRA's ability to accommodate users and still provide a good quality recreation experience indicate that, at current population trends, optimum capacities will be reached at Blue Mesa Reservoir by about 1992 and at Morrow Point Reservoir by about 1983 (National Park Service, 1979). A survey made during the 1977 recreation season indicated that 77 percent of the use was by Colorado residents, who were predominantly from the state's urban centers (National Park Service, 1979). Only 5.9 percent of the use came from Gunnison County residents.

NFS lands in the Basin provide both developed and dispersed recreational opportunities.

Local residents contributed about 3.7 percent of all use at developed sites, and about 40 percent of downhill skiing. Local contributions to dispersed recreation in recent years have been: camping and hiking-11 percent; fishing-51 percent; and hunting-12 percent.

Public lands managed by the BLM in the Basin include three developed recreation sites (BLM, 1980). All are campgrounds. They are located in the southern part of the basin and have 30 camping units. Data on use levels are not available.

PROJECT AREA USES

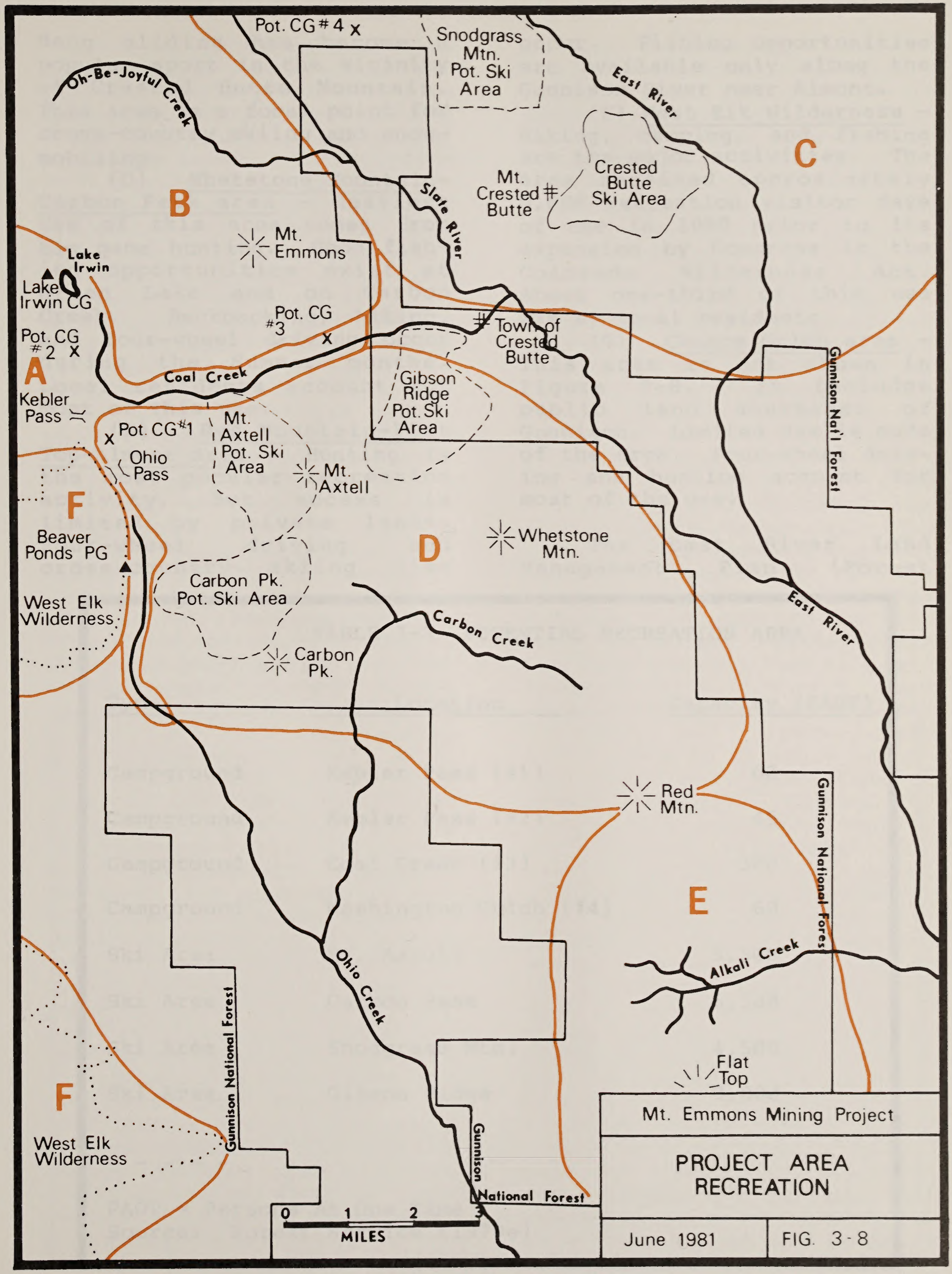
Numerous existing and potential recreation areas are in the immediate vicinity of Mt. Emmons Project. These are shown in Figure 3-8. Existing developed sites include Crested Butte Ski Area, Beaver Ponds picnic ground, and the following campgrounds: Lake Irwin, Gothic, Avery, Cement Creek, and Almont.

The following areas shown in Figure 3-8, receive regular dispersed use:

(A) Upper Coal Creek area - The principal use is recreational driving. The Coal Creek, Lake Irwin, and Ohio Pass roads are popular routes for pleasure driving and scenic viewing. The Swampy Pass trailhead (a major access point to the West Elk Wilderness) is also located in this area. Cross-country skiing and snowmobiling are popular during the Winter months. Hunters use the area in the Fall. People camp and fish at Lake Irwin in the Summer. Some people fish the upper reaches of Coal Creek, but not as much on the lower reaches.

(B) Mt. Emmons-Oh-Be-Joyful area - Hiking, hunting, backpacking, and four-wheel driving are the principal recreation activities. Much of the historic four-wheel drive use in the Gunsight Pass-Mt. Emmons-Redwell Basin area is currently restricted because of access limitations. Some four-wheel drive activity continues to occur in the Oh-Be-Joyful drainage and around Lake Irwin. Oh-Be-Joyful, Peeler Basin, and Scarp Ridge are popular hiking and backpacking areas.

(C) Slate River-East River area - Recreation activities include driving for pleasure and scenic viewing along the Gothic, Washington Gulch, and Slate River roads. Limited hiking and camping occur on Snodgrass Mountain.


Pot. CG # 4 X
Snodgrass Mtn. Pot. Ski Area
Oh-Be-Joyful Creek
East River
C
Crested Butte Ski Area
Mt. Crested Butte
Slate River
B
Mt. Emmons
Lake Irwin
Lake Irwin CG
Pot. CG #3 X
Pot. CG #2 X
Town of Crested Butte
A
Coal Creek
Gibson Ridge Pot. Ski Area
Kebler Pass
Mt. Axtell Pot. Ski Area
Pot. CG #1 X
Ohio Pass
Mt. Axtell
F
Gunnison Nat'l Forest
Whetstone Mtn.
Beaver Ponds PG
D
Carbon Pk. Pot. Ski Area
West Elk Wilderness
East River
Carbon Creek
Carbon Pk.
Red Mtn.
Gunnison National Forest
E
Alkali Creek
Ohio Creek
Gunnison National Forest
F
Flat Top
West Elk Wilderness
Gunnison National Forest
0 1 2 3
MILES

Mt. Emmons Mining Project

PROJECT AREA RECREATION

June 1981

FIG. 3-8

Hang gliding has become a popular sport in the vicinity of Crested Butte Mountain. This area is a focal point for cross-country skiing and snowmobiling.

(D) Whetstone Mountain-Carbon Peak area - Heaviest use of this area comes from big game hunting. Good fishing opportunities exist at Green Lake and on Carbon Creek. Backpacking, hiking, and four-wheel driving occur during the Summer months. Local residents account for most of this use.

(E) Red Mountain-Flat Top-Almont area - Hunting is the most popular recreation activity, but access is limited by private lands. Four-wheel driving and cross-country skiing also occur. Fishing opportunities are available only along the Gunnison River near Almont.

(F) West Elk Wilderness - Hiking, camping, and fishing are the major activities. The area received approximately 9,800 recreation visitor days of use in 1980 prior to its expansion by Congress in the Colorado Wilderness Act. About one-third of this use was by local residents.

(G) Chance Gulch area - This area is not shown in Figure 3-8. It includes public land southeast of Gunnison. Limited use is made of the area. Four-wheel driving and hunting account for most of the use.

The East River Land Management Plan (Forest

TABLE 3-3 POTENTIAL RECREATION AREA

Type	Location	Capacity (PAOT)
Campground	Kebler Pass (#1)	60
Campground	Kebler Pass (#2)	45
Campground	Coal Creek (#3)	300
Campground	Washington Gulch (#4)	60
Ski Area	Mt. Axtell	5,300
Ski Area	Carbon Peak	6,500
Ski Area	Snodgrass Mtn.	4,500
Ski Area	Gibson Ridge	9,000

- - - - -

PAOT = Persons At One Time
Source: Forest Service (1979e)

Service, 1979c, d) inventoried a number of locations in the Project area having the potential for future recreation development. These are shown in Figure 3-8 and summarized in Table 3-3. Although the potential campgrounds are suitable for development, it is unlikely that they will be developed. Maintenance and administrative costs are excessive when dealing with such small, scattered sites. Those at high altitudes have a short season of use, which further reduces their cost effectiveness. In addition, three of the sites are in the Coal Creek drainage, which is the Town of Crested Butte's municipal water supply. Current policy does not encourage further development in this area.

A discussion of the inventoried potential ski areas is in Appendix B of the East River Land Management Plan Final EIS (Forest Service, 1979d). The total potential capacity of these areas is more than five times that of Crested Butte Ski Area's present capacity. Of these, only Snodgrass Mountain is being considered for development in the near future.

Both Mt. Axtell and Carbon Peak are rated as 'good' sites for ski areas. The principal drawbacks to their development are a lack of good public access and a shortage of private lands at or near their bases for the construction of base facilities. Gibson Ridge, which is mostly on private land, would need a small area of NFS land near its top for complete development. It has been classified by the Forest Service as not suitable for development except in combination with the Mt. Axtell area. It is judged not suitable by itself because of the lack of variety and limited opportunity for intermediate and advanced skiing.

Snodgrass Mountain has been classified as 'fair' when combined with the existing Crested Butte Ski Area. Although it does not offer as many skiing opportunities as Carbon Peak or Mt. Axtell, it does have the advantage of an existing base area facility. It would tend to localize skiing use and absorb it into the present infrastructure. Interest in its development as an expansion of the Crested Butte Ski Area has been expressed by Crested Butte Mountain Resort, which is currently pressing for its development.

There appear to be only limited opportunities to increase or improve dispersed recreation in the Project area. Improved access is perhaps the best tool available. Discussions with Taylor River Ranger District personnel indicate that the creation of more and better access is generally not warranted at this time. Two exceptions are the Swampy Pass trailhead and the Lake Irwin spillway. The former is cramped and cannot always accommodate the vehicles that are parked there. The latter is a rough crossing and keeps many visitors from reaching the main portion of the Lake Irwin campground.

Problems that have been identified include the following: (1) Traffic volumes on the Ohio Pass road are beginning to pose safety hazards. (2) Beaver Pond picnicground is underutilized because of difficult access. (3) The Lake

Irwin campground access road across the spillway is difficult for many users. (4) Dispersed recreation in the Coal Creek drainage complicates the maintenance of water quality. (5) Conflicts between snowmobiles and cross-country skiers continue to grow. (6) Off-road vehicle resource damage is occurring in the vicinity of Red Mountain, especially during hunting seasons. (7) Subdivision developments and changes in ownership of private lands are beginning to restrict public land access along the East River and Ohio Creek valleys. (8) Developed facilities are experiencing more and more days at full capacity.

Although information on developed sites indicates that levels fall well below capacity, this is misleading. Percent of use is computed on a season-long basis and includes days of both high and low use. Campgrounds, particularly those on the Taylor River Ranger District, are frequently at capacity during periods of heavy use. This may indicate a need for minimum facility overflow areas, new concepts in developed site design, new opportunities for the private sector to pursue, and other solutions. Crested Butte Ski Area is a case in point. Season-long statistics indicate considerable unused capacity, yet the number of days at full capacity continues to grow.

PROJECTED USES

Both dispersed and developed recreation uses in the upper Gunnison Basin are expected to increase as the national population grows. This increase is summarized in Figure 3-9. A detailed breakdown by recreation type is in Forest Service (1981a).

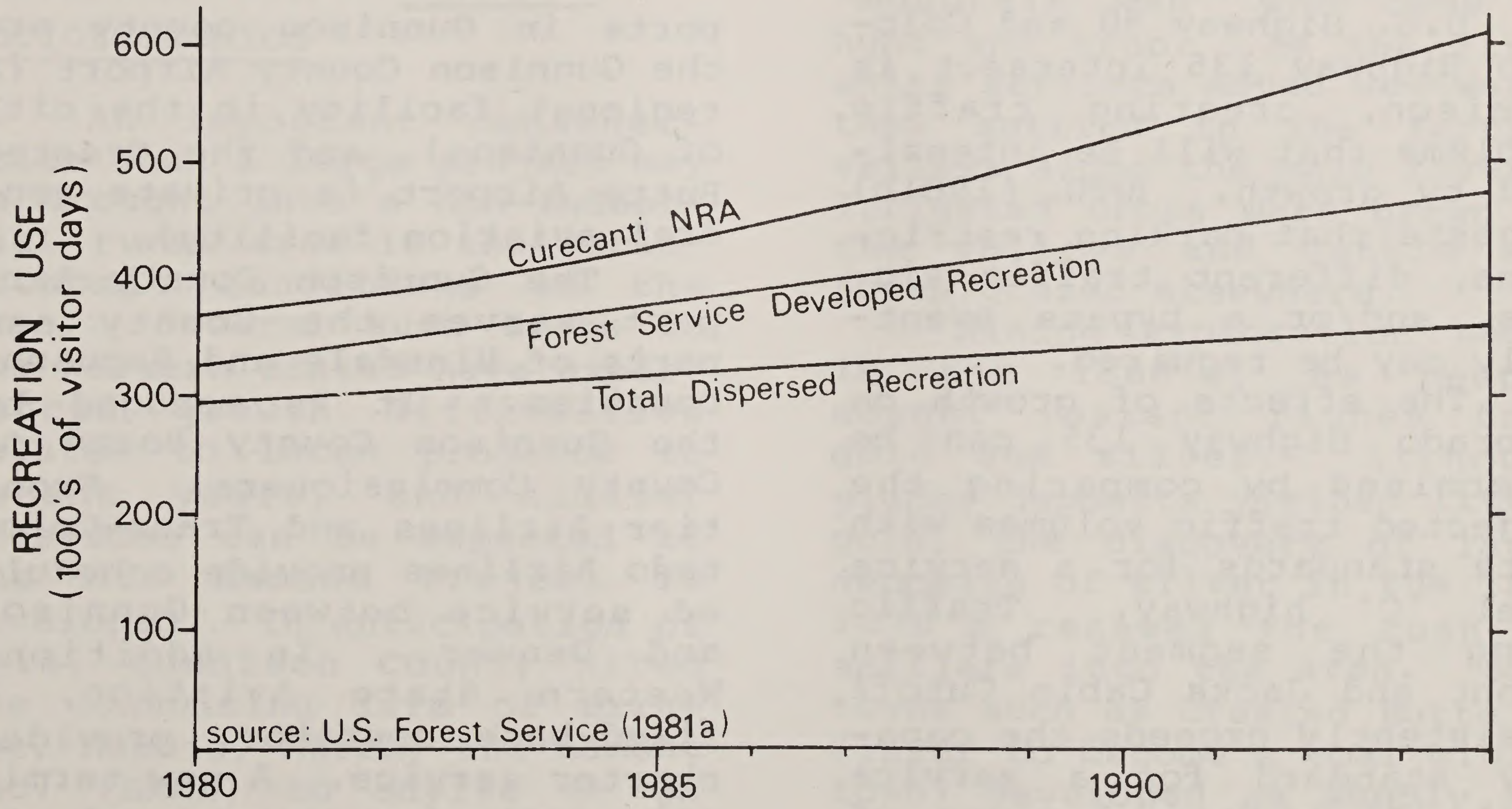


Figure: 3-9 PROJECTED OUTDOOR RECREATION

FIRE

Federally administered lands in the Gunnison Basin constitute over 78 percent of Gunnison County lands and experience an average 19 fires per year. About half of the fires are caused by people, while lightning causes the rest. About 84 percent of all fires occur on NFS lands and 60 percent of those occur on the Taylor River Ranger District. Historically, about 74 percent of all fires have been controlled at a size less than one acre.

TRANSPORTATION

The transportation system in Gunnison County consists of highways and roads, airports at Gunnison and Crested Butte, and limited bus service.

Road System - U.S. Highway 50 and Colorado Highway 135 are the only arterial roads in the County.

U.S. Highway 50 and Colorado Highway 135 intersect in Gunnison, creating traffic problems that will be intensified by growth. BMML (1981b) suggests that parking restrictions, different traffic signals, and/or a bypass eventually may be required.

The effects of growth on Colorado Highway 135 can be determined by comparing the projected traffic volumes with state standards for a service level 'C' highway. Traffic along the segment between Almont and Jacks Cabin Cutoff consistently exceeds the capacity standard for a service level 'C' highway because of inadequate design. Traffic volumes have been increasing steadily on Colorado Highway 135 and are heaviest during the Summer (BMML, 1981b).

According to State standards, Colorado Highway 135 for the Almont to Crested Butte segment is hazardous. Even without growth, BMML (1981b) suggests that improvements are needed on the Almont to Jacks Cabin Cutoff segment. No major improvements for Colorado Highway 135 or U.S. Highway 50 are included in the State's current five-year plan.

Gothic Road, a county collector, primarily serves Mt. Crested Butte. Its capacity is often exceeded during the ski season and considerable maintenance is required. Merrick and Associates, consultants to the County, indicate that improvements on the Gothic Road costing $1.4 to $2.9 million are needed to serve current and projected demands (BMML, 1981b). Further studies are planned by the County.

Airports - The two airports in Gunnison county are the Gunnison County Airport (a regional facility in the city of Gunnison), and the Crested Butte Airport (a private general aviation facility).

The Gunnison County Airport serves the County and parts of Hinsdale and Saguache counties. It is managed by the Gunnison County Board of County Commissioners. Frontier Airlines and Trans-Colorado Airlines provide scheduled service between Gunnison and Denver. In addition, Western State Aviation, a fixed-base operator, provides charter service. A new terminal, expansion apron, and related improvements were completed in 1980. Jet aircraft are often unable to use the airport during the summer because of the runway length and warm daytime temperatures. There are no runway lights for night use.

The number of air passengers to Gunnison more than doubled between 1967 and 1977 (BMML, 1981b). Frontier Airlines has, nevertheless, announced plans to discontinue service to Gunnison in 1981.

The Crested Butte Airport is a private, general aviation airport. During the Winter, fog and low visibility limit use. Colorado Airlines has daily service to Denver and Aspen and also serves as a fixed-base operator.

Bus - The Gunnison area is served by Continental Trailways. Its terminal is in Gunnnison. The Mountain Express Bus Service serves skiers by providing service between Crested Butte, Mt. Crested Butte, and the Gunnison County Airport.

SOCIOECONOMICS

An important consideration when a large project may be brought into a non-industrial rural area is the socioeconomic conditions in the area. Several such areas in the Western states have experienced growth difficulties related to large projects in recent years, and similar pressures can be expected if the Mt. Emmons Project is developed. In anticipation of this, Gunnison County hired the consulting firm of Briscoe, Maphis, Murray and Lamont Inc. (BMML) to advise it on preparing for growth. Both AMAX and the Forest Service contributed funds to the study.

BMML worked with local governments, the Forest Service, and AMAX. It reported its findings through the Colorado Joint Review Process (CJRP). The results of BMML's work can be found in BMML (1980a, b, and 1981a-d), which are incorporated by reference. The following discussion is based partly on these findings and partly on Snider (1981), and AMAX (1981a, Section 4.2) which are also incorporated by reference.

The discussion below focuses on the period 1980-1994 because this will be the major period of adjustment if the Mt. Emmons project is developed. It is assumed that the trends of this period will continue in similar fashion beyond 1994.

HISTORICAL BACKGROUND

Prior to the mid-1800's, the only residents of the area were Ute Indians and a few 'mountain men' who came to hunt and trap. As the first white settlers moved westward, they settled in the fertile valleys along the main rivers. Irrigated crops were grown in the valleys and cattle and sheep grazed elsewhere.

Mining exploration began in the 1860's, as people sought instant riches from gold and silver. Although placer deposits yielded little gold, the discovery of large deposits of silver in the late 1870's renewed the rush of settlers into the area. Boom towns such as Crested Butte (later to become a coal mining town) developed as supply and service centers.

Mining activity stimulated the developemnt of rail transportation. By 1880, the

Denver and Rio Grande Railroad had established a line to Gunnison. It was a prosperous community providing supplies and services to farmers, ranchers and miners. In 1881, the line was extended to Crested Butte.

The discovery of extensive deposits of anthracite coal around this time marked the beginning of another mining boom. As coal mining progressed, the area gained national recognition as a coal center. The coal mining industry prospered until competition from alternative fuel sources forced the closing of the Big Mine operated by the Colorado Fuel and Iron Company in 1952. This created an economic void that left Crested Butte in a depressed condition. Gunnison, while affected by the cessation of coal mining, had a more diversified economy and was better able to maintain a healthy economy. In 1962, Crested Butte began a slow economic recovery with the advent of the ski resort.

Western State College in Gunnison has grown steadily from approximately 850 students in 1956 to 3,150 today. The recreation and tourism industry is a sustaining and growing industry for the communities of Gunnison, Crested Butte, and the County as a whole. Ranching, while a long-time sustaining industry in the County, has declined in economic importance.

LAND OWNERSHIP

Gunnison County is the sixth largest county in Colorado, encompassing 3,238 square miles. The Forest Service manages 1,204,676 acres of the 1.6 million acres in Federal ownership, which accounts for 58.3 percent of the total acreage in the County.

SOCIETY

Population - Although large in land area, Gunnison County is one of the most sparsely populated of Colorado's counties, with about 3 persons per square mile. This is largely because nearly 80 percent of the County is in Federal ownership.

Population estimates vary somewhat from source to source (Snider, 1981). Those displayed by BMML (1980a, b) are used in this discussion. Community and County population estimates for the period 1980-1994 are in Table 3-4. It is assumed that the growth rates reflected in these figures will continue without appreciable change beyond 1994.

Demographics - In 1970, about 40 percent of the population was 15 to 24 years old, many being college students or newcomers attracted by the ski area. The population is younger than Colorado and national averages and is expected to remain so through 1994 (BMML, 1981a). Only onethird of the County's residents have lived in the County for more than eleven years (Community Response Inc., 1979).

In 1980, the people in Gunnison County were better educated than in 1970. In 1980, two-thirds of the County's adult population had attended college (BMML, 1981a). The level of education for County residents is not expected to change between 1980 and 1994.

The average Gunnison County household size varied from 3.25 persons per household in 1960 (U.S. Bureau of the Census, 1960) to 2.87 in 1970 (U.S. Bureau of the Census, 1970), to 2.65 in 1979 (Community Response Inc., 1979). The average household size for 1994 is projected to be 2.9 (BMML, 1981a).

Organizations - There are over a hundred governmental, private, and volunteer agencies in Gunnison County offering a wide range of religious, civic, social, political, educational, and cultural opportunities and services. The college also provides many cultural and educational opportunities not always available in a rural community. Currently there are 14 religious organizations; 11 service organizations; 8 art, music and theater groups; 15 welfare and public health associations; 10 youth groups; 27 sport and recreation clubs; and 15 women's organizations.

Social Characteristics - Several characteristics of Gunnison County society distinguish it from previously studied rapid growth rural communities:

(1) Gunnison County's population increased by two-thirds during the period 1970-1979. This translates into an average annual growth rate of nearly 6 percent. An estimated 82 percent of the residents have lived in the County 20 years or less, while nearly half have been in the County 5

TABLE 3-4 CURRENT AND PROJECTED POPULATION IN GUNNISON COUNTY

Year	City of Gunnison	Gunnison Fringe	Crested Butte	Mt. Crested Butte	Remainder of County	Total
1980	6,061	2,147	1,146	243	3,031	12,628
1981	6,195	2,155	1,171	249	3,056	12,826
1982	6,343	2,164	1,198	256	3,085	13,046
1983	6,582	2,178	1,242	266	3,130	13,398
1984	6,869	2,195	1,295	279	3,184	13,822
1985	7,135	2,210	1,344	291	3,234	14,214
1986	7,461	2,229	1,405	305	3,298	14,698
1987	7,733	2,246	1,455	317	3,347	15,098
1988	9,036	2,263	1,510	330	3,407	15,546
1989	8,365	2,283	1,157	344	3,470	16,033
1990	8,698	2,302	1,633	359	3,532	16,524
1991	9,054	2,323	1,698	375	3,600	17,050
1992	9,461	2,347	1,773	393	3,676	17,650
1993	9,872	2,371	1,850	411	3,754	18,258
1994	10,320	2,398	1,932	431	3,839	18,920

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Source: BMML (1981a, Table 6.3-J)

years or less. An estimated 7 percent are County natives.

(2) Most previously-studied rapid growth communities had a predominantly agricultural economy prior to rapid growth. In contrast, only 8 percent of the Gunnison County work force and about 3 percent of its total gross output are involved with agriculture.

(3) Tourism is a major contributor to the economic base in Gunnison County. Thousands of visitors are attracted to the area each year. Total visitor days in 1978 have been estimated at 968,893.

(4) Western State College brings large numbers of students to Gunnison County each year. WSC enrollment during the 1978-1979 school year totaled 3,150 students. Ninety-five percent of the students are from outside the County, while 18.5 percent are from outside the State. Approximately 23.8 percent of the estimated 1979 Gunnison County residents (12,589) are out-of-County Western State College students.

(5) The physical and social environment is very important to Gunnison County residents. The Gunnison County resident survey asked respondents to list three things they liked about the area (Community Response Inc., 1979). The nine most prevalent responses concerned aspects of the physical and social environment.

(6) Unlike most areas that have experienced rapid growth, plans for the Mt. Emmons Project were announced some four to five years before the various permitting processes required for development will achieve final rulings. Consequently, an extensive pre-planning process is in progress.

Characteristics (1) through (4), taken in aggregate, indicate not only that there is a constant stream of new faces in the area, but that long-time residents, newcomers, students, and casual visitors interact in a variety of commercial, recreational, and other activity settings. The recreation-tourism industry and Western State College add diversity to the social, cultural, and demographic makeup of the community that is not found in communities whose economies are based primarily upon one industry, such as agriculture. These sectors, added to the mining, manufacturing, commercial, and professional sectors in the community, offer a wide variety of opportunities for social interactions, relationships, and by extension, social support systems. This suggests that Gunnison County residents are accustomed to diversity and change in their social interactions.

INCOME AND EMPLOYMENT

An important measure of overall economic and human well-being is income, and per capita income is a good indicator of an area's standard of living. Per capita income for the period 1960-1977 is shown in Table 3-5 for both Gunnison County and the State of Colorado. During this period, Gunnison County per capita income has not kept pace with the Statewide average. Table 3-6 also indicates this pattern.

TABLE 3-5 PER CAPITA INCOME

YEAR	GUNNISON COUNTY	COLORADO
1960	$1,643	$1,855
1969	2,559	3,106
1972	3,013	4,142
1974	3,762	4,902
1975	4,014	5,193
1977	4,839	7,166

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Source: Snider (1981)

Added to Gunnison County's lagging per capita income are increased living expenses, high transportation costs for both businesses and consumers, and high rents induced by chronic housing shortages.

The working population of Gunnison County is comprised of four general employment groups: non-managerial sales, clerical, and services (39 percent); professional, technical, and managerial (29 percent); craftsmen, operatives, transport, and labor (23 percent); and agricultural managers and laborers (8 percent) (U.S. Bureau of Census, 1970).

The tourism-related services industry generates the largest employment group (sales, clerical, and services), which should continue to dominate the employment mix in the future. The next largest employment group (professional, technical, and managerial), should remain relatively constant in the future, largely due to the stable enrollment levels projected for the college (BMML, 1981a). The craftsmen and laborers should continue to grow, largely to support tourism-related housing and facility expansion. The agricultural employment group is expected to

TABLE 3-6 INCOME DISTRIBUTION IN 1974

Income Group	Gunnison County	State of Colorado
Less than $3,000	8.4%	6.6%
$3,000 - $4,999	9.3%	5.2%
$5,000 - $7,999	22.1%	14.0%
$8,000 - $9,999	12.8%	11.2%
$10,000 +	47.4%	63.0%

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Source: Snider (1981)

decline slightly. Employment by industrial sector is shown in Table 3-7.

A great deal of the employment in Gunnison County is seasonal which is common in a tourism-recreation-based economy. Other sustaining industries in the County are also seasonal. For example, timber industry activities generally take place from May to October. The ranching industry has peak labor needs during Spring and Fall roundups and during hay cutting time. The college work force drops sharply during the Summer. Peak employment periods in the County are July-August and December-January.

Gunnison County has not suffered from high unemployment over the last decade. Unemployment in Gunnison County has consistently been lower than that in the region, but higher than the Statewide average. The low unemployment rate in conjunction with relatively low per capita incomes in the County is a possible indication that a significant amount of underemployment exists. Job opportunities requiring a high skill level and providing a high income are insufficient; thus, persons with skills deserving of higher pay are forced to take lesser jobs to remain in the area.

TABLE 3-7 ANNUAL AVERAGE EMPLOYMENT BY SECTOR IN THE GUNNISON TRADE AREA

Sector	1977	1978	1979
Mining	*	*	*
Contract Construction	89	212	296
Manufacturing	76	*	176
Transportation & Public Utilities	*	79	*
Wholesale Trade	37	62	73
Retail Trade	711	720	818
Finance, Insurance & Real Estate	208	227	273
Services (Lodging, amusement & recreation, health, etc.)	543	658	733
Agriculture	235	230	226
Subtotal	2139	2527	3011
Government (Federal, State & Local)	749	777	866
TOTAL	2888	3230	3722

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* = Not published due to disclosure restrictions

Source: Snider (1981)

RETAIL SALES

In 1980, Gunnison County's estimated retail sales volume was $55 million. This volume is projected to increase to $86.7 million in 1994 (Denver Research Institute, 1981). Gunnison County's present retail sales capture rate is approximately 70 percent of total disposable personal income (Denver Research Institute, 1981). ('Capture rate' is an economic term which describes how much of the disposable per capita personal income is actually spent in the County in the form of retail sales.) The projected growth in population in Gunnison County could cause the capture rate to increase to about 84 percent, which is typical of other counties (Montrose, Moffat, and Routt). If this occurs, retail sales will increase to an estimated $104.5 million by 1994 (Denver Research Institute, 1981).

ASSESSED VALUATION

Gunnison County's 1979 assessed valuation for property tax purposes was $33.4 million. From 1972 to 1979 the assessed valuation increased by an average of 10.0 percent per year. This is less than the 11.7 percent Statewide average annual increase during the same period, and less than the increase in comparative counties.

The 1979 assessed valuation per capita in Gunnison County was $3,012, 70 percent of the Statewide average. The assessed valuation per capita of the County is also below other comparative rural counties. In contrast, counties where resource development is occurring have had higher assessed valuations per capita.

Projected assessed valuations in Gunnison County through 1994 are shown in Table 3-8.

HOUSING

Housing in Gunnison County is becoming a problem. The housing construction industry is limited and most new housing development has provided recreation units and second homes instead of the moderately priced residential units that are seriously needed. Rental units are not being developed despite a strong demand, particularly by college students. Development of housing has been complicated by inflation in the price of materials and labor, high mortgage rates, changing local government regulations, and land speculation. These conditions may cause the housing situation to deteriorate even more unless public and private incentives for improving housing are developed.

BMML estimated the number of housing units in the County in 1979, including seasonally-occupied units, to be 5,700 (BMML, 1980b). Of this total, 47 percent are located in or near the City of Gunnison; 29 percent are located in Crested Butte, Mt. Crested Butte, the East River valley, and Ohio Creek valley; and 24 percent are in the rest of the County. The U.S. Bureau of the Census preliminary 1980 results estimate the number of units at 5,748 (AMAX, 1981a).

Single-family homes are the most common housing type in Gunnison County. Mt.

TABLE 3-8 ASSESSED VALUATIONS IN GUNNISON COUNTY

Year	Assessed Valuation*
1980	$70,100,150
1981	70,875,602
1982	73,944,452
1983	76,046,814
1984	87,893,772
1985	92,616,613
1986	103,666,468
1987	108,957,246
1988	114,118,494
1989	119,050,575
1990	125,088,638
1991	145,773,487
1992	151,383,106
1993	158,507,223
1994	165,980,073

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* Figures are in 1980 dollars

Source: AMAX (1981a)

Crested Butte is an exception with predominantly multi-family housing.

Much of the housing in Gunnison County is in poor condition. According to a survey prepared by the County (using standards from the Colorado Division of Property Taxation), 44 percent of the housing is substandard. In the City of Gunnison, 39 percent is substandard, and in the Town of Crested Butte, 54 percent is substandard (BMML, 1980b).

From census data and building permit records, BMML (1980b) concluded that approximately one-fourth of the County's housing is over 40 years old. In the City of Gunnison, 80 percent of the housing is at least 10 years old. Most of Mt. Crested Butte's housing is new.

Gunnison County has very little vacant housing. The vacancy rate dropped drastically from 24 percent in 1970 to 1 percent in 1979 (BMML, 1980b). The low 1979 rate indicates a serious shortage of units. Using 5 percent vacancy as the percentage needed to ensure an adequate choice in housing type, location, and price range, approximately 230 more housing units are presently needed countywide.

BMML (1980b) estimates from housing condition information and from population figures that some 1,270 additional units are needed in Gunnison and its immediate surroundings to replace substandard units or to supplement overcrowded units. The 230 units needed to improve the vacancy rate plus the

1,270 units total a housing deficiency of 1,500 units (BMML, 1980b).

Off campus housing for students at Western State College is in especially short supply. A sufficient number of rental units is not available to allow the 73 percent of the college students who wish to live off campus to do so. Only 426 rental units exist to serve the entire rental market in the City of Gunnison (AMAX, 1981a).

Although the demand for new housing is obvious, the housing industry has had difficulty in responding to this demand. Major factors underlying this are discussed below:

(1) Local lending institutions have not been active in the residential mortgage market. Local institutions have little home mortgage money available, and money is difficult to attract into the area from outside sources. Construction loans are also in short supply.

(2) Construction materials and labor reflect high cost market conditions. Materials often must be transported from Denver or Grand Junction. Skilled labor also must be imported from other areas.

(3) The trend in construction in Gunnison County has been toward resort developments rather than permanent homes. Much of this construction has been in the East River valley and Mt. Crested Butte.

(4) The Gunnison area has only four or five months per year of predictable construction weather, which limits construction flexibility and makes scheduling difficult.

(5) The availability of land for development is limited. Land acquisition costs are high, especially for small parcels close to existing urban areas. In many cases, utilities are expensive and their availability is uncertain.

In recognition of these difficulties, the Gunnison County Housing Authority has been created. This Authority intends to assist by developing housing for lower-income and elderly persons. Local government is also involved in the process of improving its land development regulations and policies. Recent changes by the City of Gunnison include adoption of a Master Plan, a Planned Unit Development Ordinance, and new utility regulations.

By 1994, the housing need without the Mt. Emmons project is estimated to increase by approximately 2,315 units, a 41 percent increase (BMML, 1981a). The additional units are expected to be located as follows: 67 percent (or 1,548 units) in or near the City of Gunnison; 29 percent (669 units) in the Town of Crested Butte, Mt. Crested Butte, East River valley, and Ohio Creek valley, and 4 percent (98 units) in the other parts of the County (BMML, 1981a). At 5 dwelling units per acre, these additional units would use 480 acres (BMML, 1981a).

Single-family dwellings are expected to remain in short supply and to continue to be expensive (BMML, 1981a). Even without the Mt. Emmons project, multi-family dwellings and mobile homes will be needed to serve 48 percent of the housing demand over the next 14 years. The increasing demand for housing in the County may cause prices in the City of Gunnison to increase sharply unless the housing supply is expanded. Presently, there is little impetus for large housing developments other than recreational developments.

The present situation of limited single-family housing development, resort development instead of permanent homes, and no development of rental housing for college students, is likely to continue.

INDUSTRY

The principal sustaining industries in Gunnison County are tourism, education, and agriculture.

Tourism has historically been a major contributor to the economic base of Gunnison County. Total visitors in 1980, including skiers, hunters, and fishermen, is estimated to be slightly more than 1 million people (BMML, 1981a). The influence of tourism on the local economy is reflected through retail sales and services, and is seasonal in nature.

Western State College is an important contributor to the Gunnison economy. The College currently has 250-275 employees. This figure drops significantly in the summer. Many local businesses derive a significant proportion of their sales from the 3,200 - 3,500 students who attend the college.

Agriculture, which is dominated by ranching, has not experienced significant fluctuations in the value of production or sales over the last few years (BMML, 1981a). The general trend has been a slight decline in the production of both cattle and hay, and this trend is expected to continue. Part of the decline has been due to the closure of marginal operations, and part to the conversion of ranchland into housing developments.

Although mining has had sporadically strong influences on the Gunnison County economy in past decades, in recent years it has only been a minor factor. This is typical of areas in the Colorado mineral belt, which has high mineral potential but only occasional noteworthy discoveries. Coal production is currently increasing in the northwest part of the County near Somerset.

Current and projected total gross output of the Gunnison trade area is shown in Figure 3-10. The trade area includes most of Gunnison County except for the northwest portion. Total gross output represents total sales within the trade area and sales to outside buyers (exports).

LOCAL GOVERNMENTS

Gunnison County's three major communities--Gunnison, Crested Butte, and Mt. Crested Butte--have a diversity of attitudes, lifestyles, and architecture.

Descriptions

Gunnison County - Gunnison County is governed by three elected County commissioners and five elected County officers. Gunnison County has land-use permitting

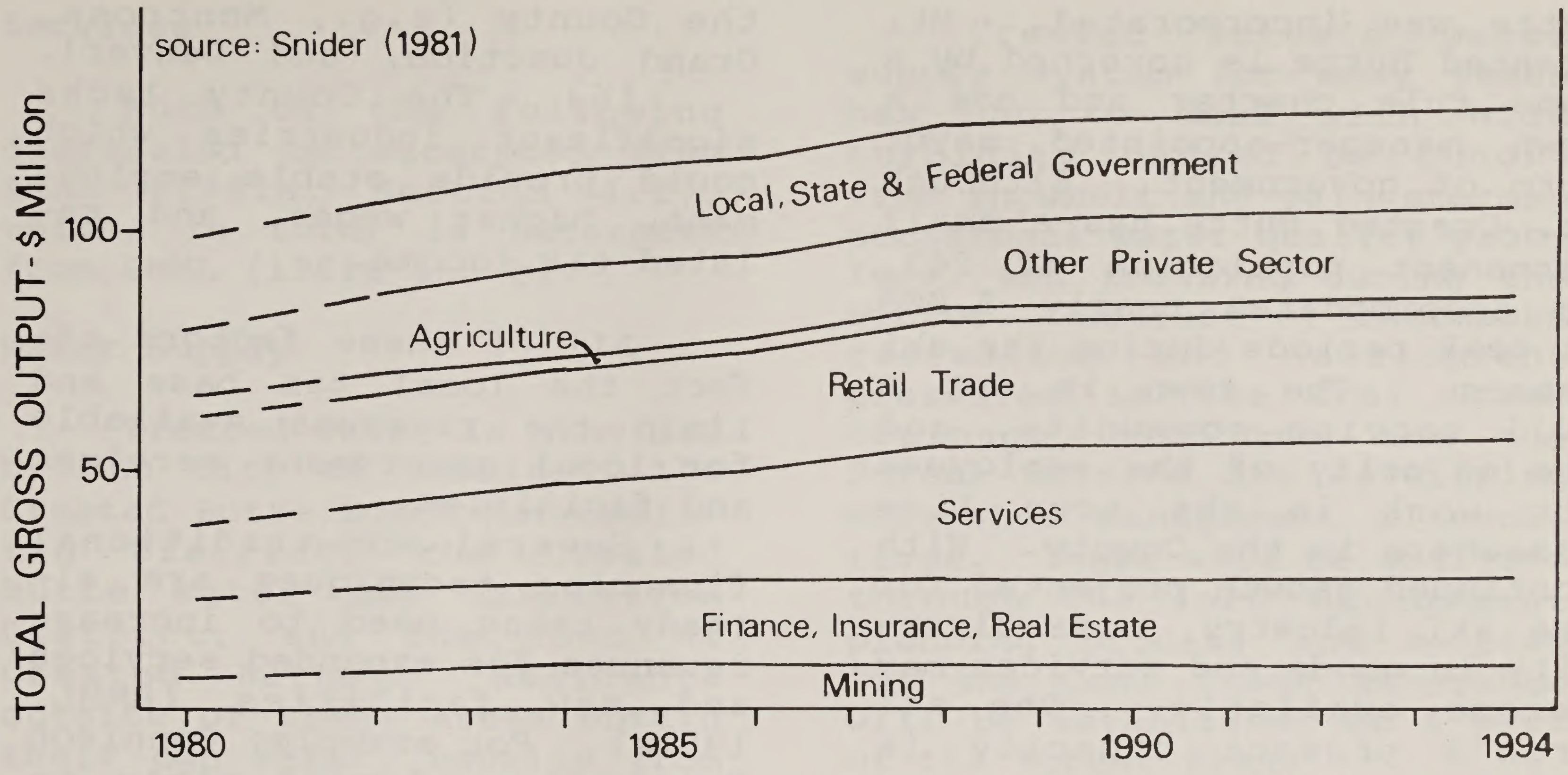

source: Snider (1981)

Figure: 3-10 TOTAL GROSS OUTPUT WITHOUT MT. EMMONS (1978 Dollars)

authority for unincorporated areas, including the Mt. Emmons Project.

The County's major expenses are for roads, bridges, and law enforcement. In recent years, land-use planning has become important in the County. In 1971, Gunnison County developed a zoning plan. In 1977, all County land use regulations were combined under a comprehensive land-use resolution.

Gunnison County now has a variety of additional services and programs: area-wide wastewater management, computerized land-use data collection, and intergovernmental coordination programs such as the Colorado Joint Review Process.

City of Gunnison - The City of Gunnison is the commercial, residential, medical, educational, and civic center for the County and is the County seat. The City of Gunnison is governed by a home rule charter, and has a city manager-mayor form of government.

The City of Gunnison is projected to continue as the County's center of commercial growth. Few physical constraints to growth exist in and around Gunnison, and both the City and County land use plans suggest that Gunnison should continue as the County's main population center. Gunnison's recently-adopted Master Plan provides for annexations, utility extensions, and land use guidelines for orderly growth.

Town of Crested Butte - The Town of Crested Butte is a National Historic District. It is governed by a home rule charter and has a town manager-mayor form of government. The Town is the major retail, restaurant, and entertainment area for Crested Butte Mountain Resort (CBMR).

Mt. Crested Butte - In the early 1970's, the CBMR Ski Area grew considerably, and in 1974 the town of Mt. Crested

Butte was incorporated. Mt. Crested Butte is governed by a home rule charter and has a town manager-appointed mayor form of government. Although Mt. Crested Butte has a small permanent population of 243, it accommodates nearly 5,000 at peak periods during the ski season. The town is not a full service community, and the majority of the employees who work in the town live elsewhere in the County. With continued growth projected for the ski industry, more diversity in goods and services may become available. The ski area's present capacity is 4,300 skiers.

Financial Condition

The City of Gunnison, Town of Crested Butte, town of Mt. Crested Butte, and Gunnison County have a relatively weak economic base for funding public facilities and services (BMML, 1981b). This results from several factors:

(1) Recreation and tourism provide the greatest number of jobs in the County, but many of these jobs are seasonal and low paying.

(2) Western State College students do not contribute a great deal to local government revenue.

(3) Part of the tourist industry is on federal land, which is tax-exempt. So is Western State College.

(4) Income from livestock sales is variable.

(5) Although the City of Gunnison is a retail trade and service center, it does not provide complete services, and residents frequently purchase goods and services outside of the County (e.g., Montrose, Grand Junction, and Denver).

(6) The County lacks significant industries which could provide stable employment, higher wages, and related tax income.

All of these factors affect the local tax base and limit the revenues available for local government services and facilities.

Several non-traditional financing techniques are already being used to increase revenues for expanded services and new facilities (BMML, 1981a). For example, Gunnison County transferred title to its courthouse and is leasing the building back to pay for courthouse renovations. Also, the County is financing both the courthouse and airport improvements from sales tax revenues rather than the traditional method of issuing bonds redeemed through property taxes. The City of Gunnison relies on transferring utility funds, particularly the electric utility funds, to the general fund to help pay for general government expenses. The Town of Crested Butte has adopted a real-estate transfer tax. Mt. Crested Butte relies on use tax revenues from new construction and sales tax revenues from skiing-related tourism, both of which are volatile.

Projections made by BMML (1981b) indicate that Gunnison County and the Town of Crested Butte will have difficulty financing many of the services they provide during the period 1980-1994. Mt. Crested Butte and the City of Gunnison, on the other hand, are projected to operate in the black.

Services

Much of the following discussion is excerpted from AMAX (1981a, Section 4.2), which, in turn, is excerpted from BMML (1981a and b).

Water Supply

Treated water is provided by the City of Gunnison, the Crested Butte South Metropolitan District, the Crested Butte Water and Sanitation District, and the Town of Crested Butte. Residents outside of these areas obtain their own water, usually from wells. Existing water rights are adequate for considerable future growth (BMML, 1981b).

The City of Gunnison uses nine shallow wells. This water now requires minimal treatment, and the service is adequate. New wells may be needed to serve the projected growth. Increased use of septic tanks near the wells could reduce the water quality in the wells. Gunnison owns water rights on the Gunnison River.

The Town of Crested Butte obtains water from Coal Creek, and to a lesser extent from Wildcat Creek. The main water intake is on Coal Creek upstream of the Keystone Mine drainage. It is on Gunnison National Forest. The water is piped to a terminal reservoir where it is treated before being distributed. Crested Butte's water treatment plant has a capacity of 0.5 million gallons per day. This plant is currently operating at capacity (BMML, 1980b). The Town has started preliminary investigations for a second plant which would double its capacity.

Crested Butte's water supply system for many years has had to deal with high turbidity caused by runoff from snowmelt and rain storms, occasional water quality problems, and freezing during the winter. Because of increased recreation and development pressures in the Coal Creek drainage, the Town and the Forest Service are developing watershed management alternatives. These will be analyzed through the land management planning process and a plan for the Coal Creek watershed will be established as a part of the Forest Plan.

Wastewater

Wastewater treatment services in Gunnison County are provided mainly by (1) the City of Gunnison, (2) Dos Rios Sewer District, (3) the Town of Crested Butte, (4) Crested Butte Water and Sanitation District, and (5) Crested Butte South Metropolitan District. Individual septic tank systems are used in many of the unincorporated areas of the County.

Projected wastewater treatment needs by the year 2000 are: City of Gunnison and Dos Rios Sewer District, 3.4 million gallons per day (mgd); and the Upper East River valley, 0.9 mgd. This compares with existing capacities of 1.7 mgd and 0.4 mgd, respectively (BMML, 1981b).

The City of Gunnison is preparing a regional wastewater treatment facilities plan (a Section 201 plan under the Clean Water Act). The Town of Crested Butte, the County, Mt. Crested Butte and Crested Butte Water and Sanitation District are about to begin similar studies in the Upper East River valley. These studies should identify treatment expansion options and allow specific treatment plans to be developed.

Electricity

Electric service is provided by the City of Gunnison and GCEA. The City can accommodate projected population increases with existing utilities. However, if development occurs on the City's west side, a new substation may be needed (BMML, 1981b).

Solid Waste

Two areas are available in Gunnison County for solid waste disposal. The City of Gunnison has a landfill, with 3 to 6 years of capacity remaining. An additional 107 acres will be needed by the year 2000 (BMML, 1981b). The towns of Crested Butte and Mt. Crested Butte use the Crested Butte landfill which has a 3 to 5 year capacity remaining. This is a temporary landfill, and would be closed and replaced if an Upper East River valley transfer station, which would utilize a county-wide landfill site, is established. A collection system is operated by the City of Gunnison. Collection is also done by private companies.

Law Enforcement

For a rural area, Gunnison County has a relatively high crime rate. Although the County has only 17 percent of the population of the Seventh Judicial District of Colorado, it accounts for 35 percent of the District's crimes. There have been significant increases in criminal offenses between 1978 and 1980.

There are five law enforcement organizations in the area: the Colorado Highway Patrol, the Gunnison County Sheriff's Department, the Crested Butte Marshall's Office, the Mt. Crested Butte Police Department, and the City of Gunnison Police Department.

Fire Protection

Fire protection is provided by two fire districts using volunteer firemen: the Gunnison County Fire Protection District and the Crested Butte Fire Protection District.

The Gunnison County Fire Protection District serves the City of Gunnison and most of the unincorporated area, with the exception of some outlying areas beyond the study area (e.g., Somerset, Marble). The District is supported by the City of Gunnison and a district-wide mill levy, and has no bonded indebtedness. The District, headquartered in Gunnison, has a part-time chief and 35 volunteers. By 1994, the number of volunteers needed is projected to increase to 54 (BMML, 1981b).

The Crested Butte Fire Protection District provides services to Crested Butte, Mt. Crested Butte, and surrounding areas. The District has 24 volunteer firemen and is projected to need a total of 57 by 1994 (BMML, 1981b). Financial support comes from a property tax levy and certain contract fees.

Projected baseline growth will affect both fire districts' ability to continue to provide satisfactory service (BMML, 1981b). According to BMML, the growth could lead to a deterioration in service and increase in costs. Through 1994, the property tax base for the Gunnison County District is expected to grow at an annual rate of about 5 percent and at a rate of about 10 percent for the Crested Butte District.

General Government Services

General government services include planning, administration, finance, and computer services and are funded from general tax revenues.

Gunnison County employs 56 people and is expected to employ 84 by 1994 (BMML, 1981b). It is among those counties with the highest number of staff per 100 population. This could be the result of a tourist based economy and a small population base. Gunnison County provides library services financed by a mill levy. There is one library in the City of Gunnison and a branch in Crested Butte. The current library system is at capacity, and expansion of services and facilities will be necessary to serve additional population (BMML, 1981b).

The City of Gunnison maintains a city hall which is now at capacity. The City employs 23 people (not including the law enforcement) and is projected to employ 39 people by 1994 (BMML, 1981b). Crested Butte's town hall is at capacity (BMML, 1981b). The Town's 1980 staff of 11 is projected to grow to 16 by 1994. The town of Mt. Crested Butte has a new town hall with space available for expansion. The town had a staff of 5 in 1980 and is projected to have 6 by 1994.

Urban Recreation

Recreation opportunities are provided by Gunnison County, the three principal municipalities in the County, Western State College, Gunnison Watershed School District (RE-1J), and other recreation facilities operated on a commercial basis.

Gunnison County has an annual fair and rodeo. The County provides no other organized recreation, but does participate with the Forest Service and other agencies in recreation planning.

The City of Gunnison in conjunction with Western State College and the Gunnison Watershed School District (RE-1J) provides the most extensive indoor recreation services in the County. The City has a Park and Recreation Department supported from the general budget. Due to extensive public participation in athletics, present facilities are not sufficient to meet current demand (BMML, 1981b). Both WSC and the Gunnison Watershed School District offer their recreation facilities for some public use.

The Town of Crested Butte has a recreation department which also offers services to Mt. Crested Butte. Mt. Crested Butte has a recreation coordinator. The Crested Butte programs tend to serve residents while the Mt. Crested Butte programs serve visitors.

The demand for new facilities will continue to increase. BMML (1981b) projects that by 1994 the Gunnison County region will need approximately 132 acres of developed parks and greater indoor recreation capacity (perhaps a facility built in conjunction with one of the schools).

Schools

The Gunnison Watershed School District (RE-1J) includes most of Gunnison County and part of Saguache County.

The School District receives the major part of its operating revenue from property taxes levied for its general fund and from state equalization payments.

The 1980-81 estimated total enrollment is 1,503, which is 73 percent of capacity. BMML (1981b) projects enrollment to reach 3,921 by 1994. BMML estimates that approximately four elementary schools, one additional junior high school, and one senior high school will be needed without the Project by 1994, assuming that schools the same size as existing schools are built. Other additional capital requirements include 50 to 100 acres of land and 22 buses. This growth should be able to pay its own way with the financing techniques available to the school districts (BMML, 1981b).

Some vocational-technical training is presently provided at the high school. The Delta-Montrose Vocational-Technical Training Center, located in Montrose, is the nearest vocational-technical school.

GEOLOGY

GENERAL

The geology of the Project area consists of a series of Cretaceous and Tertiary sedimentary rocks that were intruded by igneous masses during late Tertiary times. Associated with this intrusive phase was local mineralization, of which the Mt. Emmons ore body is one result. Figure 3-11 is a general geologic map of the area. Additional information is in the following reports, which are incorporated by reference: AMAX (1981a, Section 4.3.2) CDM (1980n), Cochran (1980a, b), Cochran and Robinson (1979, 1980), Delong and Stewart (1979), Gaskill, et. al. (1967), Hedlund and Olson (1974), Olson (1976), Robinson (1980), Sennett and Robinson (1980), Tweto, et. al. (1976), and Walsh (1980c).

MINE AREAS

The area around the Coal Creek mine site (Figure 3-12) is underlain by Cretaceous and Tertiary sedimentary rocks that strike to the northeast and dip to the southeast. The sedimentary rocks on the west side of Evans Basin and Elk Basin have been intruded by one or more sills composed of rhyodacite porphyry. Glaciers eroded the bedrock and developed cirques in Red Lady, Elk, and Evans basins and on the northeast slopes of Mt.

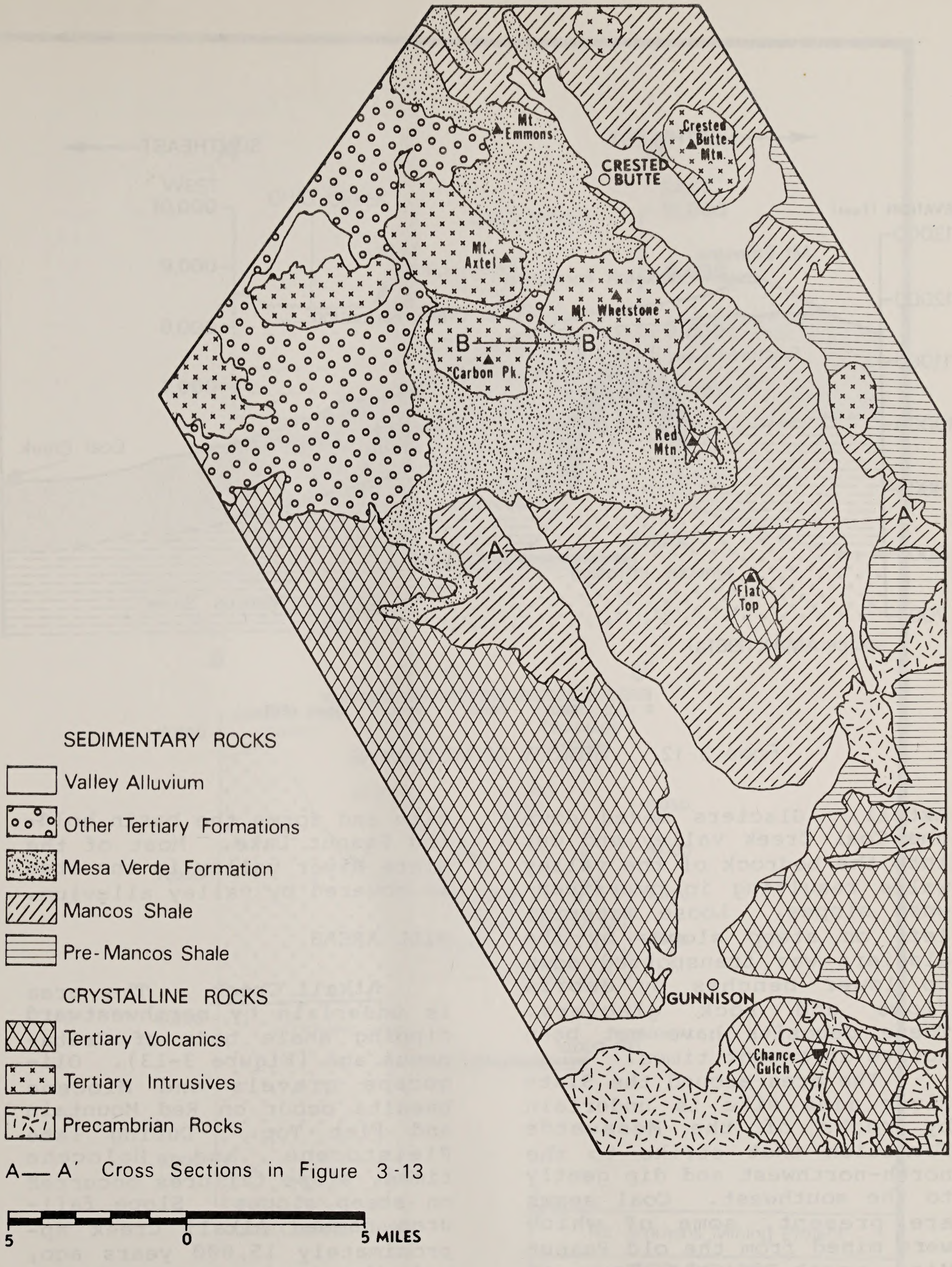
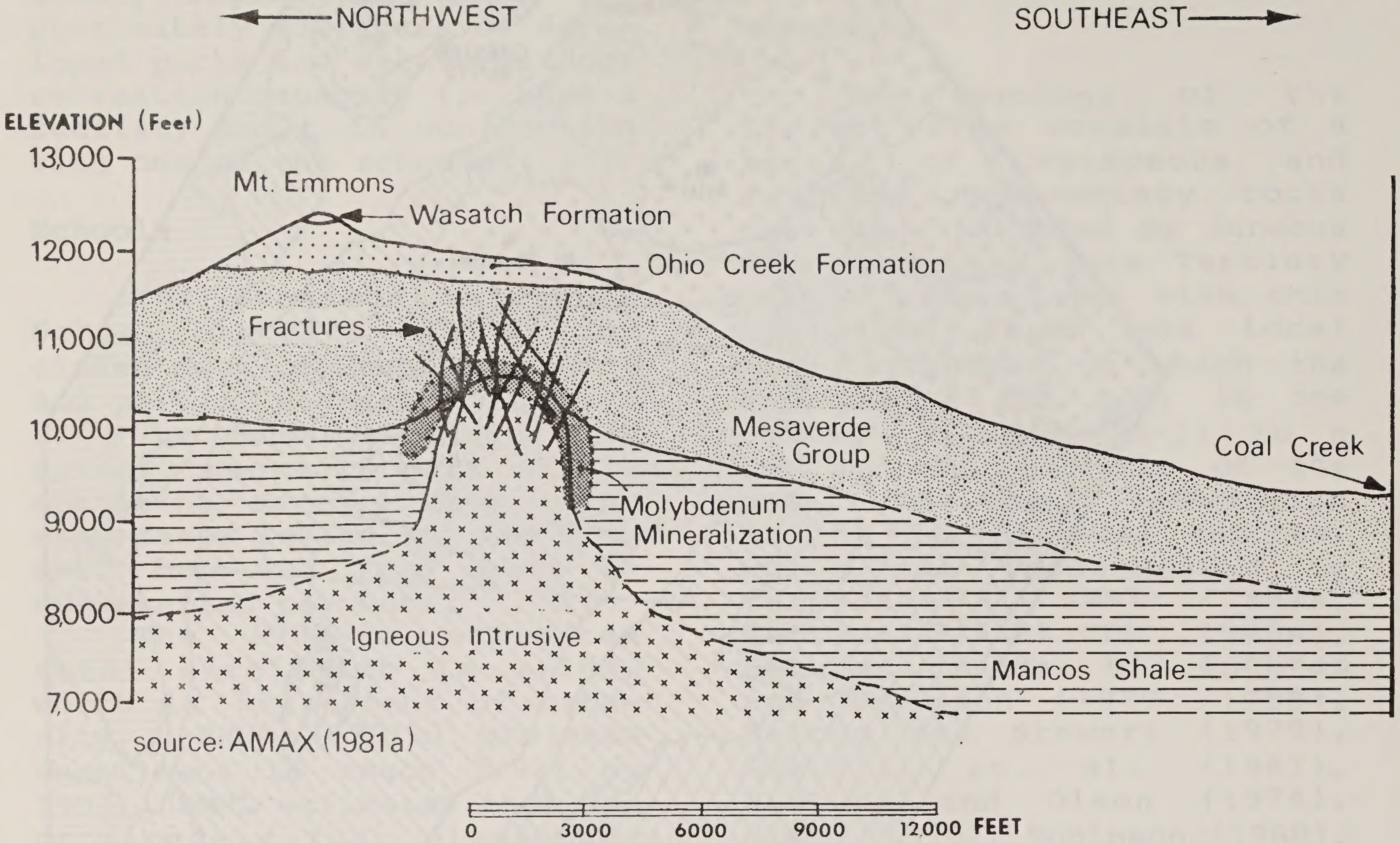

Mt. Emmons
Crested Butte Mtn.
CRESTED BUTTE
Mt. Axtel
Mt. Whetstone
B
B
Carbon Pk.
Red Mtn.
A
A'
Flat Top
GUNNISON
C
C'
Chance Gulch
SEDIMENTARY ROCKS
Valley Alluvium
Other Tertiary Formations
Mesa Verde Formation
Mancos Shale
Pre-Mancos Shale
CRYSTALLINE ROCKS
Tertiary Volcanics
Tertiary Intrusives
Precambrian Rocks
A— A' Cross Sections in Figure 3-13
5
0
5 MILES

Figure: 3-11 GENERAL GEOLOGY of the GUNNISON-CRESTED BUTTE AREA


NORTHWEST
SOUTHEAST
ELEVATION (Feet)
13,000
12,000
11,000
10,000
9,000
8,000
7,000
Mt. Emmons
Wasatch Formation
Ohio Creek Formation
Fractures
Mesaverde Group
Coal Creek
Molybdenum Mineralization
Igneous Intrusive
Mancos Shale
0
3000
6000
9000
12,000 FEET

source: AMAX (1981a)

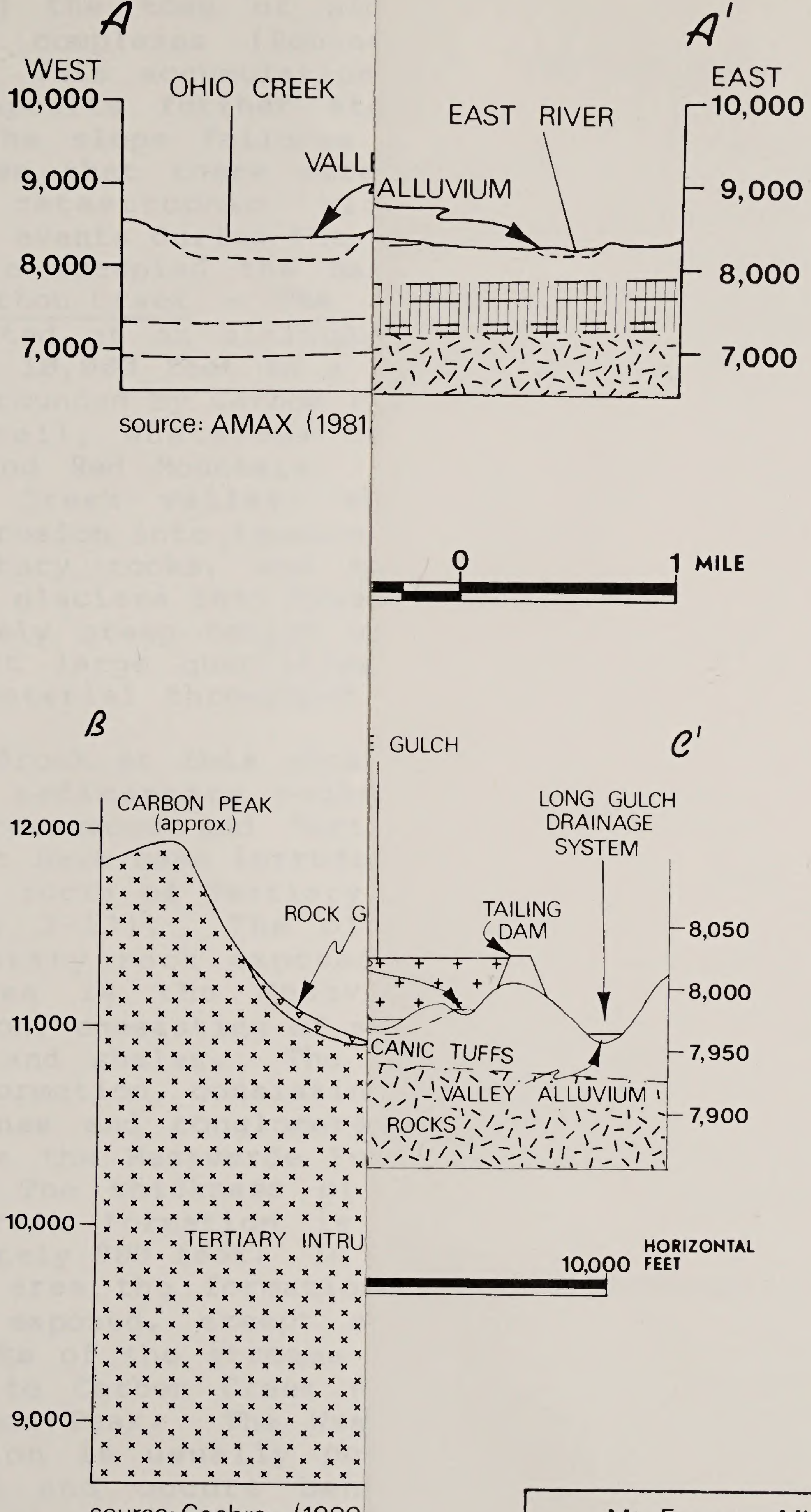
Figure: 3 - 12 GEOLOGY OF MT. EMMONS

Axtell. Glaciers moved down the Coal Creek valley and cut into the bedrock of the valley walls resulting in oversteepened slopes. Loose material left on steep slopes by the glaciers was transported down to lower benches by debris flows and rock glaciers. These deposits have not been active in recent times.

The area around the Slate River mine site is underlain by rocks of the Mesaverde Formation that strike to the north-northwest and dip gently to the southwest. Coal seams are present, some of which were mined from the old Peanut Mine north of the Town of Crested Butte. Glacial moraine covers the Slate River valley bottom near the mine site and forms the basin holding Peanut Lake. Most of the Slate River valley in the area is covered by valley alluvium.

MILL AREAS

Alkali Creek - The area is underlain by northwestward dipping shale beds of Cretaceous age (Figure 3-13). Oligocene gravels and Miocene basalts occur on Red Mountain and Flat Top. During late Pleistocene and Holocene times, slope failures occurred on steep slopes. Slope failures dammed Alkali Creek approximately 15,000 years ago, and the basin began filling with fine-grained sediment. A study of pollen in the lake deposits indicates that the


A
A'
WEST
EAST
10,000
9,000
8,000
7,000
OHIO CREEK
EAST RIVER
VALL
ALLUVIUM
0
1 MILE
B
C'
12,000
11,000
10,000
9,000
CARBON PEAK
(approx.)
ROCK G
TERTIARY INTRU
GULCH
LONG GULCH
DRAINAGE
SYSTEM
TAILING
DAM
CANIC TUFFS
VALLEY ALLUVIUM
ROCKS
8,050
8,000
7,950
7,900
10,000
HORIZONTAL
FEET

source: AMAX (1981

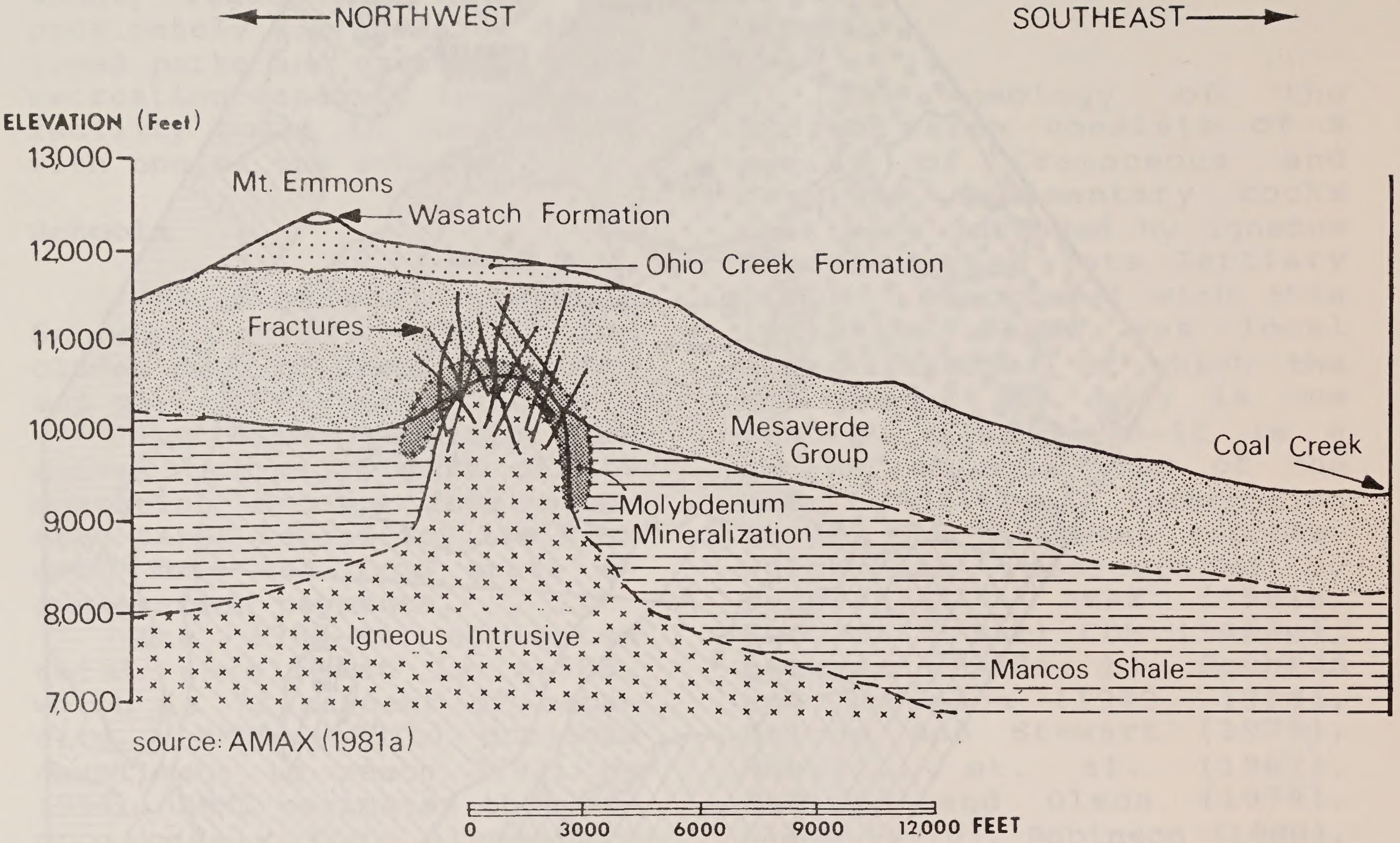
source: Cochran (1980

Mt. Emmons Mining Project

GEOLOGY OF
ALTERNATIVE TAILING
DISPOSAL AREAS

July 1981

FIG. 3-13


NORTHWEST
SOUTHEAST
ELEVATION (Feet)
13,000
12,000
11,000
10,000
9,000
8,000
7,000
Mt. Emmons
Wasatch Formation
Ohio Creek Formation
Fractures
Mesaverde Group
Coal Creek
Molybdenum Mineralization
Igneous Intrusive
Mancos Shale
0
3000
6000
9000
12000 FEET

source: AMAX (1981a)

Figure: 3-12 GEOLOGY OF MT. EMMONS

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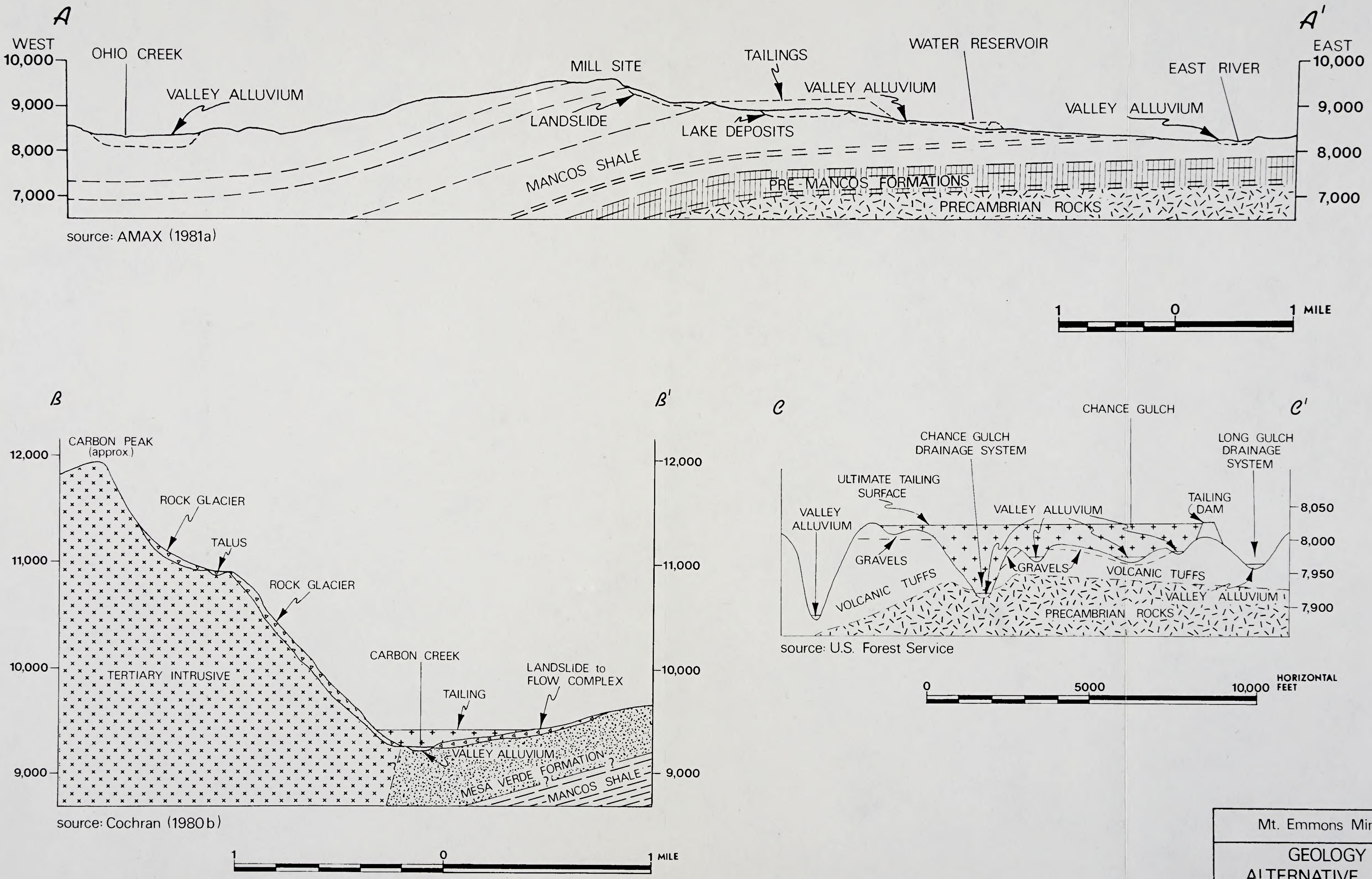

A
A'
WEST
EAST
10,000
9,000
8,000
7,000
OHIO CREEK
VALLEY ALLUVIUM
MILL SITE
LANDSLIDE
TAILINGS
WATER RESERVOIR
VALLEY ALLUVIUM
LAKE DEPOSITS
EAST RIVER
VALLEY ALLUVIUM
MANCOS SHALE
PRE-MANCOS FORMATIONS
PRECAMBRIAN ROCKS
1 0 1 MILE
B
B'
12,000
11,000
10,000
9,000
CARBON PEAK (approx.)
ROCK GLACIER
TALUS
ROCK GLACIER
TERTIARY INTRUSIVE
CARBON CREEK
TAILING
LANDSLIDE to FLOW COMPLEX
VALLEY ALLUVIUM
MESA VERDE FORMATION
?
MANCOS SHALE
1 0 1 MILE
C
C'
CHANCE GULCH
CHANCE GULCH DRAINAGE SYSTEM
LONG GULCH DRAINAGE SYSTEM
ULTIMATE TAILING SURFACE
VALLEY ALLUVIUM
VALLEY ALLUVIUM
TAILING DAM
GRAVELS
GRAVELS
VOLCANIC TUFFS
VOLCANIC TUFFS
VALLEY ALLUVIUM
PRECAMBRIAN ROCKS
8,050
8,000
7,950
7,900
0 5000 10,000 HORIZONTAL FEET

source: AMAX (1981a)

source: Cochran (1980b)

source: U.S. Forest Service

Locations of cross sections are shown on the General Geologic Map.

Mt. Emmons Mining Project

GEOLOGY OF ALTERNATIVE TAILING DISPOSAL AREAS

July 1981

FIG. 3-13

filling of the basin continued at a constant rate, eventually covering the toes of slope-failure complexes (Robinson, 1980). This accumulation of lake deposits further stabilized the slope failures and indicates that there were no major catastrophic slope-failure events during the time the lake occupied the basin.

Carbon Creek - The area is located at an altitude of 9,500 - 10,000 feet in a valley surrounded by Carbon Peak, Mt. Axtell, Whetstone Mountain, and Red Mountain. The Carbon Creek valley, which shows erosion into igneous and sedimentary rocks, was modified by glaciers that have cut relatively steep canyon walls and left large quantities of loose material throughout the area.

Bedrock at this site includes sedimentary rocks of late Cretaceous and Tertiary age that have been intruded by igneous rocks of Tertiary age (Figure 3-13). The oldest sedimentary rock exposed in the area is the Mesaverde Formation, consisting of sandstones and shales. The Ohio Creek formation, consisting of sandstones and conglomerates, overlies the Mesaverde Formation. The thickness of the Ohio Creek Formation is approximately 900 feet. In most of the area the formation is poorly exposed, except along the banks of the streams tributary to Carbon Creek north of Carbon Peak. The Wasatch Formation is usually poorly exposed and occurs beneath surficial deposits of rock glaciers, talus, and morainal deposits. Igneous rock constitutes most of the mass of Carbon Peak, Mt. Axtell, and Whetstone Mountain.

Chance Gulch - The lower end of Chance Gulch is a basin approximately 1.5 miles wide and 2.5 miles long. Basically, the floor of the basin and the south wall is composed of Precambrian metasedimentary rock (Figure 3-13). The three other sides oF the basin are composed of a series of bedded gravels, volcanic flows, agglomerates and tuff beds.

The Precambrian metasedimentary rock that forms the lower slopes at the north end and the floor of the basin is intensely fractured and contains numerous zones of sheared rock. The surface of the metasedimentary rocks rises gradually southward on the floor of the basin and abruptly above the floor to form the slopes at the south end of the basin.

Successive volcanic units consisting of andesite flows, agglomerates, and welded and nonwelded tuff were deposited in the vicinity. Some of the units contain rock fragments derived from the local Precambrian and sedimentary rock units. An extensive period of erosion, followed by the deposition of a thick blanket of gravel, occurred between periods of volcanism.

A notable feature in Chance Gulch is the general lack of gullying. Precipitation runoff appears to be slight to non-existent, and the underlying deposits are permeable enough to allow for rapid infiltration.

EARTHQUAKES

At the present time, Colorado is a minor seismic risk area. The Colorado Geological Survey recently conducted an extensive investigation of earthquake potential in Colorado (Kirkham and Rogers, 1978). A search of all events within a 199 mile radius of the Mt. Emmons project indicated 229 reported events. Of these, 17 were within a 62 mile radius of the project area. Only two historic earthquakes within a 62 mile radius of the project area caused damage.

ECONOMIC DEPOSITS

The Project area lies in the Colorado Mineral Belt, which is the dominant metals-producing area in Colorado. Mines of varying but generally modest size have operated in the Crested Butte vicinity for a hundred years, producing gold, silver, and coal, among others.

The old Keystone mine lies a quarter-mile east of the Coal Creek mine site. It began operation in the 1880's and has intermittently produced silver, lead, zinc, and copper since then. It has not been active in recent years. The property consists of several contiguous patented claims (Figure F-3 on page 372) which cover a portion of the Mt. Emmons molybdenite ore body.

Known deposits of minerals in the Crested Butte area include coal, manganese, iron, silver, lead, gold, zinc, barite, nickel, copper, uranium, and marble, in addition to molybdenum. The Crested Butte coal field is estimated to contain about 180 million tons of coal at depths of less than 3,000 feet (BLM, 1979, p. 84).

The major valley bottoms contain abundant sand and gravel.

SOILS

The following general discussion of soils in the project area is taken from Walsh (1980a).

Soils on the valley bottoms of the rivers and creeks of the Project area formed on alluvium. They are generally deep, nearly level, and poorly or somewhat poorly drained. Textures are loams and sandy loams. They occur on flood plains, terraces, and alluvial fans between 7,500 and 9,500 feet in elevation. Many of these soils underly irrigated hay meadow and pasture land. The Evanston, Gas Creek, and Irim are the principal soils on the valley bottoms.

Colluvial soils occur on the mountain sideslopes. They are moderately deep, well to moderately well drained, stony loams. They occur between 9,500 and 11,500 feet in elevation. The principal soils are the Nutras, Tongue River, Shadow, Tolvar, and Uinta.

Soil formed on fine-grained sedimentary rocks occur on valley sideslopes of the Slate River, East River, Ohio Creek, and Alkali Creek. They are mostly deep, well drained clay loams and clays. They occur between 8,000 and 10,000 feet in elevation. The Cochetopa, Leaps, and Jerry are the principal soils.

The reclamation potential of these and other locally-occurring soils is listed in Table 3-9.

Additional information on soils can be found in the following reports, which are incorporated by reference: CDM (1980n), Walsh (1980a, 1980b), SCS (1975,1977), and AMAX (1981a, Section 4.3.4).

TABLE 3-9 SOIL RECLAMATION POTENTIAL

SOIL UNIT	RECLAMATION POTENTIAL	SOIL UNIT	RECLAMATION POTENTIAL
Alluvial land	--	Fola	Fair-Poor
Bassel	Good-Fair	Soil G	Poor
Big Blue	Fair-Poor	Gas Creek	Fair-Poor
Blanca	Fair-Poor	Gateview	Fair-Poor
Bogan-like	Fair-Poor	Irim	Good-Poor
Cryoboralf	--	Jerry	Fair
Cryochrepts	--	Kebler	Fair-Poor
Cryoborolls	--	Leaps	Fair-Poor
Cochetopa	Fair-Poor	Mord	Good-Fair
Cryaquolls	--	Nutras	Good-Poor
Curecanti	Fair-Poor	Penitente	Fair-Poor
Disturbed land	Poor	Rockland	Poor
Dollard	Fair	Shadow	Fair-Poor
Duffson	Good-Fair	Teoculli	Good-Fair
Evanston	Fair	Tongue River	Fair-Poor
		Uinta-Tolvar	Fair
		Wetterhorn	Fair-Poor
		Youga	Good

- - - - -
Source: Walsh (1980a)

LAND USES

REGIONAL SETTING

Table 3-10 describes land ownership patterns in Gunnison County. Federally administered lands constitute over 78 percent of Gunnison County.

PRIVATE LAND USES

The Gunnison County Chamber of Commerce estimates that over 81 percent of the County's private land is used for livestock grazing. In 1976 the number of cattle on ranches was estimated at 31,000 head. Other non-government lands in the County have typical uses of urban, suburban, light industry, and recreation.

FEDERAL LANDS

Forest Service - NFS lands are dedicated to multiple uses of range, timber, wildlife and fish habitat, water, recreation, wilderness and special uses such as utility corridors, roads, and irrigation ditches. In addition, mining has and is taking place.

Details about land uses in the Project area are described in two Forest Service documents: The East River Land Use Plan (Forest Service, 1979c), and the environmental assessment for emergency withdrawal request for the Coal Creek and Oh-Be-Joyful Creek watersheds (Forest Service, 1980e).

Bureau of Land Management - These lands are administered similarly to NFS lands.

National Park Service - The National Park Service, in cooperation with the Bureau of Reclamation, manages the Curecanti National Recreation Area for public recreation and electric power generation.

LAND USE CONTROLS

Federal Lands - The BLM and the Forest Service regularly receive applications for a variety of uses. Applications are reviewed in accordance with the National Environmental Policy Act, the Federal Land Policy and Management Act, and other applicable federal laws. Acceptable uses are permitted.

Land use on the Gunnison National Forest in the area of the proposed mining project is guided by two documents. The East River Land Use Plan (Forest Service, 1979c), directs the management of National Forest resources and lands in the East River drainage including the Coal Creek and Slate River drainages and lands between Ohio Creek and the Gunnison River to the east. The management of NFS lands and resources in the Carbon Creek and upper Ohio Creek drainages is guided by a multiple use plan. This plan was approved in 1964 and last revised in 1973.

On July 11, 1979, the Forest Supervisor of the Grand Mesa, Uncompahgre and Gunnison National Forests issued special occupancy and use regulations restricting public uses in the Coal Creek municipal watershed which might degrade water quality.

Gunnison County - Gunnison County controls land uses through a Land Use Resolution. Proponents submit applications for changes in land use which are then reviewed by a planning commission. Following a process which includes public meetings, the County Commissioners decide to approve or disapprove the proposed changes.

TABLE 3-10 GUNNISON COUNTY LAND OWNERSHIP, 1979

	Acres	Percent
Private	426,501	20.65
County	200	.01
State of Colorado	13,388	.65
Forest Service	1,204,677	58.34
Other Federal	420,223	20.35
TOTAL	2,064,989	100.00

Source: Gunnison County Chamber of Commerce

AVALANCHE HAZARDS

The climate and terrain of the project area commonly generate snow avalanches during the Winter. Figure 3-14 shows avalanche zones in the Project area. The discussion below is taken from Mears (1980, pages 1-2), which is incorporated by reference.

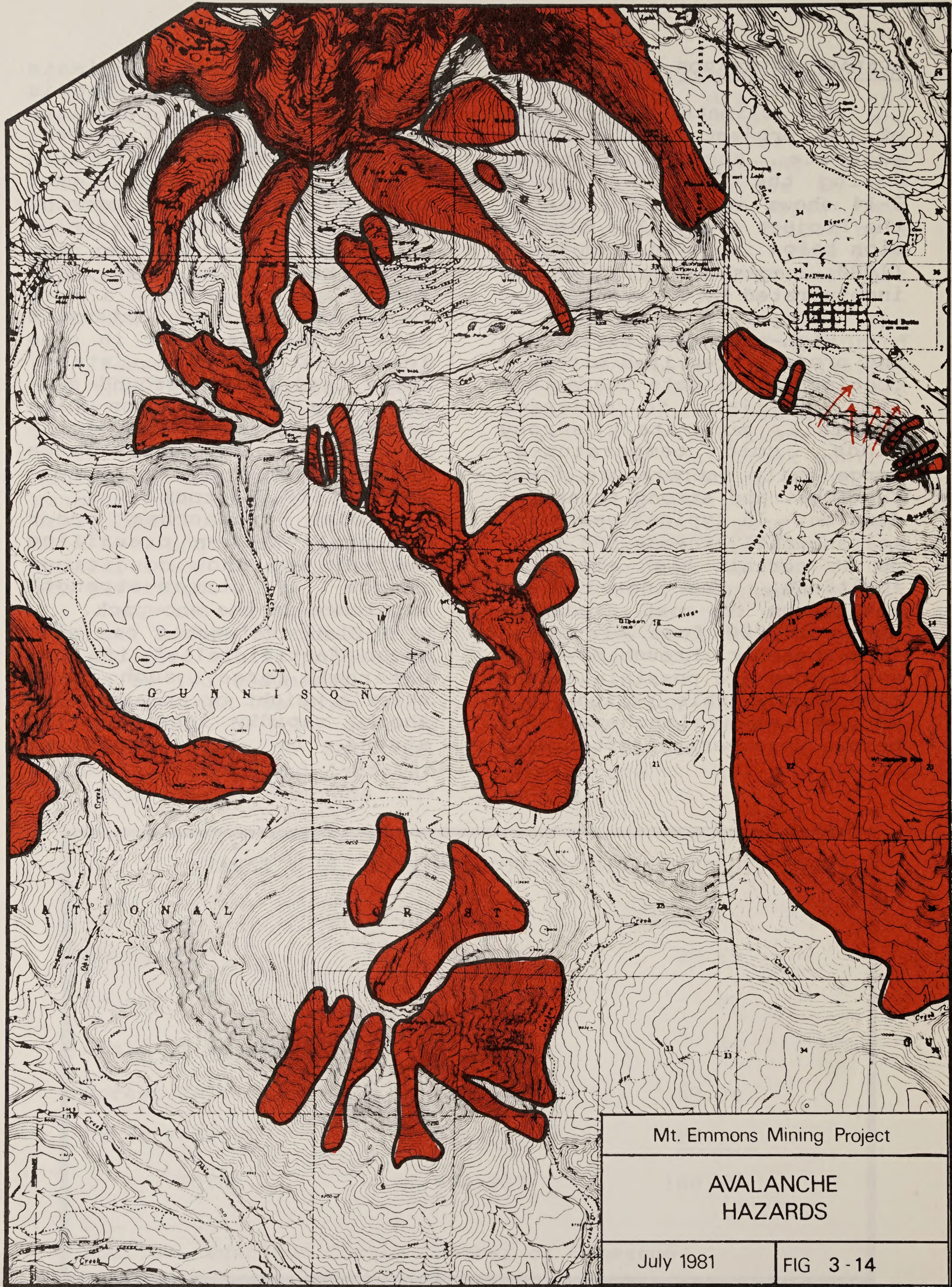
High-elevation terrain in the project area lies within a continental climate characterized by light to moderate snowfall, moderately strong winds, cold temperatures, large daily temperature fluctuations, and strong solar radiation. In typical years total snowfall exceeds 500 inches at certain high elevation locations. The snowcover is continuous on most exposures above 10,000 feet elevation from November through May, and avalanches are possible at any time during this period. On some years avalanches occur before November and after May.

The continental climate produces a snowcover that is variable in strength, density, and other mechanical properties important in causing avalanches. Avalanches in loose, cohesionless snow are common.

Slab avalanches, involving rigid fractures along distinct boundaries, are also common and constitute a more important hazard. Extensive slab avalanches occur in some locations because steep, large, and smooth ground surfaces are available upon which snowpack fracture may propagate. Slab avalanches range in mass from a few to approximately 100,000 tons.

Slab avalanches occur "naturally" when prevailing weather and snow conditions induce a stress-strength imbalance in the snowpack.

Slab avalanches can also occur "artificially" if some external force, such as a skier's weight or an explosive shock, rapidly increases the stress in the snowpack.


GUNNISON
NATIONAL FOREST
Crested Butte
Gibson Ridge
Creek
River

Mt. Emmons Mining Project

AVALANCHE HAZARDS

July 1981

FIG 3-14

CHAPTER 4. ENVIRONMENTAL CONSEQUENCES

CHAPTER 4. ENVIRONMENTAL CONSEQUENCES

PAGE REFERENCE

General Impacts 100
Mine Site 129
Mill Site 149
Production Rate 200
Power Supply. 219
Land Exchange 237
Land Classification . . . 239
Other Impacts 248

This Chapter forms the scientific and analytic basis for the comparison of alternatives presented in Chapter 2. It consolidates the discussions of those elements required by Sections 102(2)-(C)(i), (ii), (iv), and (v) of the National Environmental Policy Act which are within the scope of this EIS, and as much of Section 102(2)(c)(iii) as is necessary to support the comparisons in Chapter 2. The discussions include the environmental impacts of the alternatives including the proposed action, any adverse environmental effects which cannot be avoided should the proposal be implemented, the relationship between short-term uses of the human environment and the maintenance and enhancement of long-term productivity, and any irreversible or irretrievable commitments of resources which would be involved in the proposal should it be implemented.

This Chapter includes discussions required by the Council on Environmental Quality (CEQ) in 40 CFR 1502.16(a-h). However, the analyses in this Chapter are not organized around these discussions. To make it easier to locate these discussions, the following reference list is offered:

(a) "Direct effects and their significance": all sections of Chapter 4 except Production Rate.

(b) "Indirect effects and their significance": all sections of Chapter 4.

(c) "Possible conflicts between the proposed action and the objectives of Federal, regional, State, and local land use plans, policies, and controls for the area concerned": can be located through Land Use Plans in the Index.

(d) "The environmental effects of alternatives including the proposed action": all of Chapter 4.

(e) "Energy requirements and conservation potential of various alternatives and mitigation measures": can be located through Energy in the Index.

(f) "Natural or depletable resource requirements and conservation potential of various alternatives and mitigation measures": discussed on pages 252 through 256.

(g) "Urban quality, historic and cultural resources, and the design of the built environment, including the reuse and conservation potential of various alternatives and mitigation measures": can be found under Cultural Resources, Mitigation Measures, and Socioeconomics.

(h) "Means to mitigate adverse environmental impacts": can be found under Mitigation Measures in the Index.

The analyses discussed in this chapter are as specific as existing data permit. Some analyses are based on intensive studies that make it possible to predict impacts in considerable detail. Other analyses are based on experience and professional judgment, and for these it is more a matter of predicting the pattern or trend of impacts rather than predicting them in quantitative terms. This is adequate for making a reasoned comparison of alternatives. In the case of a few analyses, neither experience nor available data are on hand to predict even the trend that an impact might take. This is particularly true of impacts involving complex ecological relationships.

If the Mt. Emmons Project is developed, many detailed studies will be completed prior to construction, and specific approvals or decisions will be based on them. Some of these are listed below.

- Construction plans will be prepared by AMAX covering roads, powerlines, ore haulage facilities, mine and mill sites, tailing disposal facilities, and miscellaneous utility corridors. These plans will be subject to approval by various governmental entities.
- Air emissions will be analyzed once the emitting facilities are in place. Final permits will be issued by the Colorado Air Pollution Control Division if the emissions keep air quality within permissable standards.
- Favorable flow requirements will be analyzed on Carbon Creek if a potable water reservoir is to be built on that drainage.
- Detailed water supply studies will have to be conducted on the Mt. Emmons Iron Bog if it is to be preserved.
- Local population growth will be monitored for the timely construction of new or expanded public service facilities.

The analyses in the following sections are basically organized around the alternatives laid out in Chapter 2. Many of the items analyzed, such as the impacts of a certain mill site or of overhead transmission lines, are discussed using the sequence of topics adopted in Chapter 3. In some instances not all topics are discussed because no noteworthy impacts were anticipated for them.

GENERAL IMPACTS

PAGE REFERENCE

Vegetation. 101
Wildlife. 104
Aquatic Ecology 106
Energy. 106
Water 108
Air 110
Noise 112
Cultural Resources. . . . 112
Visual Resources. 114
Outdoor Recreation. . . . 116
Fire. 121
Transportation. 121
Socioeconomics. 124
Geology 126
Soils 127
Land Use. 127
Avalanche Hazards 129

The Mt. Emmons Project, if carried out, will generate a number of impacts that will occur regardless of which alternative is selected. This applies to both direct and indirect impacts. These are discussed in this section, while site-specific impacts are discussed beginning on page 129.

VEGETATION

The major effect on vegetation from the project will be direct disturbance. Most of this disturbance will be total clearing and removal for subsequent earthmoving operations. For example, a total of 3,453 acres will be disturbed by the proposed project. Vegetation not disturbed by clearing may be affected by alteration of nutrient cycling, dust, changes in surface and subsurface water supply, or changes in soil structure.

Vegetation disturbance will be greatest during construction. Reclamation programs during construction and operation will provide vegetation cover to disturbed areas. Plant communities will be rehabilitated over the long-term through natural succession processes and reclamation programs. Species richness can be either reduced or enhanced depending on specific situations. In this respect ecosystems are changed as sites are cleared, thinned, or pruned for necessary clearances.

Approximately 75 percent of vegetation disturbance will occur during construction. The remaining 25 percent will occur as the tailing pond and the subsidence zone increase in size.

Regardless of the surface location of project components, and if panel caving mining methods are used (Alternatives 2-5 and 7), subsidence will occur on the upper portions of Mt. Emmons. The maximum area that could be affected by subsidence is about 900 acres. This area is identified by vegetation types in Table 4-1.

TABLE 4-1. POTENTIAL VEGETATION DISTURBANCE FROM SUBSIDENCE OF MT. EMMONS

VEGETATION TYPE	Subsidence (at 45°) NFS ACRES
Subalpine meadow	50
Alpine meadow	139
Alpine fellfield	31
Sparse vegetation	172
Subalpine willow	29
Lodgepole pine	42
Spruce-fir	144
Rock/talus	310
TOTAL	917

The process and appearance of subsidence is described on page 115. Subsidence will also change the affected alpine and subalpine environments, which in turn will change vegetation communities. South aspects could become north aspects, snowdrift patterns will change, and the shallow soils will be essentially lost with only small pockets remaining among the rocks.

Fugitive dust and gaseous and particulate emissions will be within Colorado and Federal standards and therefore should not adversely affect vegetation. The potential for dust blowing from exposed tailing will be minimized by control measures so that there should be little impact on the plant communities adjacent to the tailing pond.

Secondary impacts will include the loss of vegetation due to community development and a loss of productivity due to recreation-related trampling of vegetation.

Mt. Emmons Iron Bog

Alteration of ground water flows by mining operations may affect the Mt. Emmons Iron Bog. As the mining zone within Mt. Emmons is dewatered, springs feeding the bog area could be disrupted. As a result, the only known Colorado population of the round-leaved sundew could be modified or lost. Although AMAX has said it will provide a secondary water source if natural sources dry up (which may require a National Pollution Discharge Elimination System (NPDES) permit from the Colorado Department of Health, there are uncertainties attached to this proposal. The survival of the sundew plant or other bog organisms could depend on narrow ranges of water temperature or trace mineral conditions that could be difficult to determine and duplicate. Because of these problems in assuring the continued existence of the Iron Bog, the following worst-case discussion is presented.

It is difficult to assess the consequences of changing the Iron Bog community to a degree that it is replaced by an entirely different plant community. The Iron Bog covers 2-3 acres and is of particular interest because of the presence of the round-leaved sundew. This is the plant's only known occurrence in the central or southern Rocky Mountains. This population of 500-1,000 individual plants would most likely be lost if the Iron Bog dried appreciably.

The bog plant community contributes little economic benefit to society. Even the Coal Creek Cattle Allotment, which the Iron Bog lies within, is not currently being used. In fact, the acid water that supports the bog contributes to the pollution of Coal Creek.

Non-monetary values attached to the Iron Bog are: ecological, scientific, educational, and the possibility of future, yet unknown, benefits.

Trampling, collection, and research efforts may also affect Iron Bog habitats. AMAX intends to cooperate in developing a management plan for the area with the Forest Service and Rocky Mountain Biological Laboratory. See Appendix A.

Molybdenosis

Through blowing dust and water transport, molybdenum in forage could increase to levels such that molybdenosis occurs in ruminant animals.

Although molybdenum (Mo) is an essential trace element in plants, levels as low as 1.5 ppm Mo in plants have been shown, under conditions of low copper levels, to cause molybdenosis. Molybdenosis is a complex toxic reaction of ruminant animals to excess molybdenum-deficient copper diets. Cattle are the most sensitive, followed in order by sheep, horses and hogs; deer are relatively insensitive (Jarrell, Page and Elseewir, 1980). Buck, Osweiler, and Van Gelder (1976) caution that when discussing the deficiency or toxicity of copper or molybdenum, it should be understood that the interaction of these elements in the presence of inorganic sulfate makes it impossible to delineate between the toxicity of one and a deficiency of the other.

Studies in drainages with upstream molybdenum mines have found molybdenum distribution in the downstream environment to far exceed the molybdenum distribution in drainage without molybdenum mines upstream (Runnells, Donald D., 1978; Thurman, E.M., and D.D. Runnells 1978; and Jordan and Meglen). While the studies do not specifically conclude that mining causes the high levels of molybdenum, they do report that the joint occurrence of molybdenum mineralization and mining are found upstream in the drainages with elevated molybdenum concentrations. If the increased molybdenum levels were caused by mining, Jordan and Meglen recognized that the mining operations studied were developed during times when environmental concerns and controls were immature or totally lacking.

The Mt. Emmons Project incorporates modern mitigation technologies designed to prevent the release and distribution of extracted minerals into the surrounding environment. Therefore, this potential effect is highly unlikely.

Threatened and Endangered Plants

No threatened or endangered plants occur on Gunnison National Forest.

The subsidence area includes habitat that could possibly support two plants proposed for threatened and endangered status, Stellaria irrigua (Bunge) (common name; starwort or chickweed) and Senecio porteri (Greene) (common name; Porter's groundsel) (USDI-FWS, 1980).

Stellaria irrigua is a small, fragile herbaceous perennial that occurs on talus slopes at 12,000 feet. In Colorado known populations occur in six counties including Gunnison County. The closest reported population to Mt. Emmons is about nine miles northeast near Mt. Bellview. "The alpine areas on Mt. Emmons were carefully searched, especially in the local areas where Ligularia soldanella grows. No individuals of Stellaria irrigua were found." (Stoecker-Keammerer, 1980)

Senecio porteri is a small, herbaceous perennial alpine plant that occupies gravelly slopes and boulder fields near 12,000 feet elevation. In Colorado, known populations occur in Gunnison and Pitkin counties. The closest reported population to Mt. Emmons is about nine miles northeast near Mt. Bellview. "The areas on Mt. Emmons were carefully searched and no individuals of the species were seen." (Stoecker-Keammerer, 1980)

Wetlands - Wetlands in the Upper Gunnison Basin consist primarily of floodplain riparian areas, contiguous to rivers and streams, mountain lakes and associated emergent zones, and scattered meadows and willow-sedge spring areas. Beaver activities throughout the region have altered stream flows and adjacent vegetation, creating wetlands and wet meadow areas. Human influences and activities, particularly seasonal irrigation of valley bottoms, have shifted many historically dry areas toward moister ecosystems. This situation would be expected to revert to historic systems if irrigation were terminated.

Population growth induced by the project will involve the construction of new housing. In the past it has been common practice to build homes in flat, easy-to-develop valley bottoms, some of which are or may be classifiable as wetlands. This sometimes runs counter to the Section 404 Dredge and Fill Permit program administered by the Corps of Engineers, which implements Section 404 of the Clean Water Act (Public Law 92-500). A permit must be issued before fill can be placed in wetlands.

Indirect impacts on wetlands may occur as a result of housing and commercial construction, but the extent cannot be forecast.

WILDLIFE

Impacts to terrestrial wildlife due to the Project include loss and alteration of habitat, direct mortality to sedentary species, displacement of mobile species, and disturbance of life cycles due to noise and human encounters. Table B-2 in Appendix B lists many of the expected wildlife impacts as well as proposed mitigation measures. Other general impacts include the loss of sedentary species with limited home ranges in construction areas; increased human population will increase the likelihood of illegal activities and require increased enforcement measures.

Primary impacts to habitats and populations will be greatest during construction. As with impacts on vegetation, approximately 75 percent of the disturbance would occur during the short-term construction phase with the remaining 25 percent occurring during the operating life of the mine. Primary impacts resulting from habitat loss or alteration will be mitigated through reclamation and habitat improvement programs.

Subsidence of Mt. Emmons under Alternatives 2-5 and 7 will affect wildlife habitat, as shown in Table 4-2.

Increased human presence and activity could lead to increases in wildlife-vehicle collisions and general life-cycle disturbances. Secondary impacts also include the regional loss or alteration of habitat from housing and service facilities and the increase in hunting pressure on game species.

Elk and Deer - Impacts on big game include disruption and alteration of habitats by Project activity and increased human presence within those habitats. Table B-2 in Appendix B summarizes many of the expected impacts on big game; it includes proposed mitigation measures. Another general big game impact not discussed above is a very likely loss of winter range to secondary development on private lands. However, controlled land use approvals by the County and the measures proposed in Appendices A and B can effectively mitigate most winter range problems.

The majority of direct impacts to big game populations will occur during construction. During operation, indirect impacts will be the main concern. Monitoring at AMAX's Henderson Mine and Mill indicates that elk and deer populations are adaptable and have not been adversely affected by mining activities in that area.

The indirect effects of increased human population may have more of an impact on big game than the direct effects of facility construction and operation. Increased intrusion by recreationists and off-road vehicles may cause increased harassment of animals. This impact can be particularly severe if harassment occurs on critical winter range, in calving areas during late May to mid-June, and dur

TABLE 4-2. POTENTIAL WILDLIFE IMPACTS FROM SUBSIDENCE OF MT. EMMONS

Habitat Type	Acres Disturbed	Index of Total Wildlife Impact*
Lodgepole Pine	42	112.14
Spruce-fir	144	256.32
Riparian	29	104.69
Dry Meadow	50	83.5
Alpine	311	469.61
Rockland/Talus	341	317.13
	917	1,343.39

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*Larger index numbers mean greater adverse impacts to the inventoried wildlife species expected to use these habitats Appendix I discusses index development.

ing migration. Likewise, the increased human population will increase the risk of big game-vehicle collisions. Educational programs directed both toward Project employees and the general public will help minimize these impacts.

The impacts to big game herds will be mitigated through site-specific and herd-specific management plans developed by the Colorado Division of Wildlife, the Forest Service, and AMAX.

Threatened and Endangered Species - No general effects resulting from the Mt. Emmons Project on threatened or endangered wildlife have been identified. Three endangered species that could possibly inhabit the project area were evaluated and determined to have no habitat within the Project area (Forest Service, 1981d). The species considered were:

Falco peregrinus anatum (American peregrine falcon)
Grus americana (Whooping Crane)
Mustela nigripes (Black-footed ferret)

AQUATIC ECOLOGY

The Project is designed so that the probability is extremely low for discharge of process water and it includes a tailing impoundment designed to prevent seepage. Water from the mine will be either used in the milling process or treated prior to discharge. Therefore, no significant impact on the aquatic ecology of Gunnison County is predicted.

A Forest Service study indicates that the population increase in Gunnison County as a result of Project development will result in increased fishing pressure in the project area and in the County (Forest Service, 1981a). This increase will probably be concentrated on the East, Taylor, and Gunnison Rivers due to the quality of fishing that presently exists and the public accessibility of these streams. Lesser increases in fishing pressure are also anticipated for the Slate River, Ohio Creek, Carbon Creek, Tomichi Creek, Lake Irwin, and the Taylor and Blue Mesa reservoirs.

The impact on aquatic organisms in the streams receiving increases in domestic wastes sent to wastewater treatment plants will depend on the capacity of the treatment facilities to handle the additional load. Increases in domestic wastes could increase nutrient and suspended solids in the receiving streams, even though it is expected that the discharges will be in compliance with Colorado and Federal requirements. The effect of increased nutrient loading would be to introduce a tendency to change the species composition of aquatic macroinvertebrates and periphyton. No change would be expected to occur in the fish species composition or population. The increased suspended solids loadings will be so small as to have no effect.

ENERGY USE AND CONSERVATION

A Large amount of energy will be required to construct the mine pad, mill pad, related facilities, tailings dams and water dams. No estimate of this consumption was made because it was assumed there would be no major differences between the various geographic locations other than the length of the access road and the energy used to construct the road. Under the No Action alternative this energy would not be consumed to develop the Mt. Emmons mine.

The operation of a molybdenum mine and mill will use primary energy at rates ranging from 131.35 million to 158.02 million Btu per ton of molybdenum disulfide (MoS_2) produced. Population growth generated by the development of the Mt. Emmons mine will use energy in patterns and trends comparable to the baseline population. A discussion of how production rates influence local energy consumption begins on page 201.

Molybdenum contributes to energy conservation and energy production in several ways. Railroad rails containing molybdenum last 60 percent longer than standard rails and thus conserve the energy used to produce replacement rails. Motor oils containing one percent molybdenum lubricant increase fuel economy by about 4 percent (Federal Railway Administration, 1980; Risdon and Gresty, 1975). Also, lubricant life is extended by a factor of three with the addition of molybdenum. Thus, around 100 pounds of oil are saved per pound of molybdenum used in lubricants. In the production and transmission of energy, the strength of alloy steels containing molybdenum makes them important in electrical power generation, oil and gas production, heat exchangers, condensers and refining equipment. Other qualities of toughness and weldability make pipeline steels that contain molybdenum important for pipeline construction, particularly in low-temperature (Arctic) regions.

Effect on Local Electricity Costs - In an inflationary economy, the cost of electricity will most likely increase to pay for increasing labor and materials costs. The rate of this increase depends on many factors including customer density, management efficiency and user characteristics. This increase in electricity cost could be expected even if no new capital investments in plant were required. Gunnison County Electric Association's (GCEA) 1980 power requirements study assumes that retail rates will increase at about the same rate as estimated inflation rates, or an average annual compound rate of approximately 9 percent.

The AMAX power demand of 55 mW amounts to about 3.7 percent of Colorado Ute's 1989 projected peak power demand. Colorado Ute is the major power supplier in Western Colorado and GCEA is one of its customers. This new demand has been incorporated into long range plans which describe an expanding demand and thus require considerable capital investment to increase generating capacity. These investments, when brought on line, do increase operating costs and tend to accelerate the rate of increase of consumer electricity costs. However, management strategies are available to offset this potential cost to local consumers.

First, loads can be stabilized. GCEA schedules its rates for an estimated average power consumption. But a large proportion of this demand is caused by Winter recreation (mainly skiing) and is weather-sensitive. If problems develop so that this weather-sensitive demand does not occur, then the rate of increase in consumer electric costs can rise more steeply. If the largest proportion of GCEA's load was stable, as it would be with the AMAX Project in operation and constituting about 51 percent of the estimated 1989 GCEA peak demand, it could serve to reduce the rate of electricity cost increases.

Second, reserve power can be sold at higher rates to other utility systems. These are called economy transactions and bring extra revenue into the system. These extra returns can be applied against the capital investments to slow the rate of increase in local customer electricity costs.

Finally, other more complex strategies are available to utility management for slowing the rate of increase in electricity costs. These can range from negotiating lower labor costs, to negotiating lower fuel costs, to finding low interest money to pay for capital investments. Because of these complexities, there can be no definitive statement regarding the effect of the Mt. Emmons Project on local electricity costs.

In the worst case, the generating capacity could be constructed with the anticipation of the Mount Emmons Project purchasing 55 mW of its capacity and then the project would not come on line. Under these conditions a great deal of pressure would develop to add a proportionate charge to all of Colorado Ute's customers to pay for the capital investment. This case assumes there is no alternative buyer for the power, which is an unlikely situation.

It is certain, however, that the transmission lines constructed to serve the Mount Emmons Project will not be a cost to other customers since AMAX has stated it will pay for them (AMAX, 1981a).

WATER

Direct Impacts - During construction, water quality impacts will be focused on suspended sediment loadings near disturbed sites. The potential for loadings will be greatest in steep terrain and at drainage crossings during periods of high runoff. Even under low-probability worst-case conditions, the sediment entering live water will be flushed downstream without significantly damaging channel morphology or fisheries habitat.

During operations, some potential for project-induced sediment loadings will remain, but the potential will be substantially lower than during construction because permanent reclamation and sediment control measures will have been installed. The effects will also be reduced.

The potential for stream pollution from toxic spills at the mine and mill sites will be quite low. Storage areas will be surrounded by berms, and runoff from the sites will be controlled and treated. The risk of accidental spills during transit to the sites will be present to some degree. AMAX will develop contingency plans for such events.

Indirect Impacts - Indirect impacts during operations will include sediment loadings from new construction, and potential wastewater treatment problems caused by a growing population. The former should be minor, assuming current County controls over site planning are continued. Wastewater is already causing problems which, without increased capacities, will become worse even without the project (AMAX, 1981a; BMML, 1981b).

The Environmental Protection Agency (EPA) has funded a wastewater planning study for the City of Gunnison, covering most of the land areas around Gunnison that might be developed and serviced by the city wastewater treatment system. It is expected that a similar study will be done (depending on funding) for the Crested Butte-Almont area. Upon approval of the Section 201 facilities plan by the State and EPA, the communities will be eligible for design and construction funds.

Approval of wastewater facilities plans by EPA is an action subject to NEPA. EPA is concerned with the impacts resulting from population growth that might be accommodated by these facilities. Such secondary impacts include impacts on air and water quality, and land use effects (conversion of agricultural lands, drainage of wetlands).

The growth potential projected for both the Gunnison and Crested Butte areas is closely tied to the Mt. Emmons Project. This draft EIS evaluates the overall growth picture for the Gunnison and East River valleys and related secondary impacts. EPA is cooperating with the Forest Service in preparing this draft EIS and will rely on its impact analyses in assessing the need for wastewater facilities.

Direct impacts of wastewater treatment plant or interceptor construction and operation will be handled separately during EPA's review of the wastewater treatment facilities plan.

Impacts on the East River and Gunnison-Tomichi Creek valleys can be expected to occur as a result of population growth associated with Project construction and operation. Wastewater treatment facilities will provide treatment for most of the flows from the incoming populations.

Following reclamation, sediment loadings from Project facilities should approximate pre-Project levels. Loadings from secondary sources may continue.

Acid Drainage - It is possible that with the passage of time water flowing through the subsidence zone may become contaminated with acid and heavy metals. A similar phenomenon led to the acid drainage that flowed out of the nearby Keystone mine. The phenomenon has been reported in other locations as well. AMAX is aware of the potential for its development following extraction of the Mt. Emmons ore body and is considering options for controlling it (Snow, 1980; Williams, 1980a). No proposals for control have been made because the problem should not arise for decades and the technology of acid drainage control is changing rapidly. Further studies are planned.

"Clean Up Coal Creek Project" - Upon purchasing the old Keystone Mine property as an early step in its land acquisition program for the Mt. Emmons Project, AMAX inherited an acid drainage problem that was polluting the lower reaches of Coal Creek. No viable fishery existed through that section, but this effect was generally remedied by dilution upon mixing with Slate River waters. AMAX undertook to correct the problem by constructing a heavy metals treatment plant near the site of the Keystone Mine. It is designed to remove the heavy metals, eliminate the acidity, and produce a discharge that will support a cold-water fishery. This discharge is authorized under a National Pollution Discharge Elimination System (NPDES) Permit issued by the Colorado Department of Health. The plant became operational in mid-1981.

Water Rights - The Project will consume water, and AMAX will have to obtain water rights before this can occur. AMAX has already filed for a number of junior rights to serve its needs, and it is likely that some senior rights will be acquired as well. No information is available on the latter. In all cases, Colorado's system of water rights adjudication will be followed in order to protect the rights of other water users. AMAX's current junior rights filings are moving toward adjudication, but even the issuance of decrees will not necessarily compel other permitting agencies to approve AMAX's proposed project configuration.

AIR

General - During construction and operation, particulates and gases will be emitted. Burning slash will temporarily introduce smoke and particulates into the air. These emissions are subject to the permitting procedures of the Colorado Air Pollution Control Division (APCD), which are expected to maintain compliance with established standards. AMAX has submitted applications (AMAX, 1980 b-c; CDM, 1980 o-t), and the Colorado APCD has already issued permits to AMAX for emission sources at the Coal Creek mine site and the Alkali Creek mill site, but the permits will not become final until the emitting facilities are constructed and known to be functioning properly. Issuance of these permits does not require other agencies to approve the same sites.

Secondary emissions will result from population growth. These include dust and carbon monoxide from traffic, particulates, and miscellaneous gases from fireplaces and wood- and coal-burning stoves. Impacts from these emissions are discussed in greater detail beginning on page 203.

Air Quality-Related Values - The Environmental Protection Agency has determined that a Prevention of Significant Deterioration (PSD) permit will not be required for the Mt. Emmons Project. Thus, a detailed analysis of impacts on air quality-related values is not required by regulation.

Existing Class I areas near the Project are the West

TABLE 4-3. AIR QUALITY IN THE WEST ELK FROM THE EMISSIONS AT ALKALI CREEK MILLING FACILITY

Emission	Averaging Time	Class I Increment	Predicted Maximum Concentration (ug/m3)
Particulate	Annual	5	< 0.1
	24-hour	10	< 0.1
Sulfur dioxide	Annual	2	< 0.1
	24-hour	5	< 0.1
	3-hour	15	< 0.1

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Source: CDM (1980r)

Elk Wilderness, La Garita Wilderness, Maroon Bells-Snowmass Wilderness, and Black Canyon of the Gunnison Wilderness. In addition, the Colorado Wilderness Act created new wilderness areas near the Project. These are: West Elk Wilderness additions, Maroon Bells-Snowmass Wilderness additions, Raggeds Wilderness, Collegiate Peaks Wilderness, Big Blue Wilderness, and La Garita Wilderness additions. These recent creations are Class II areas. Only the West Elk and Raggeds Wilderness areas are close enough for air quality impacts to be a possibility. The others are either too far away or are upwind in the regional air flow and will not be affected by Project emissions.

Pollutant concentrations in the West Elk Class I area were modelled for both the Alkali Creek (Alternatives 2-4) and Carbon Creek (Alternatives 5-6) mill sites (AMAX, 1981a). The Alkali Creek impacts are listed in Table 4-3 and are low. Total suspended particulate (TSP) concentrations from the Carbon Creek site will exceed 5 micrograms per cubic meter under worst-case (24-hour) conditions, while nitrogen and sulfur oxide concentrations will not be statistically significant (AMAX, 1981a, Section 5.4.2.4.4).

Air quality-related values in these areas have been inventoried and include: visibility, vegetation, wildlife, odor, scenery, soils, water, geologic formations, climate, weather, recreation, cultural features, and research control areas.

Adverse impacts on all of the above values, except visibility, can be defined as any anthropogenic change from the natural state, such as a decrease in growth rates caused by sulfur dioxide introduced by a coal-burning facility. Because of the low concentrations discussed above, no adverse impact is expected to result.

Visibility impacts have been modelled by EPA (1981). There is little potential for visibility impairment in the West Elk Class I area.

Acid Rain - An issue has been raised concerning the possibility that acid rain may be generated by sulfur and nitrogen oxide emissions from coal-burning facilities at the mine and mill. Acid rain is a phenomenon generally associated with emissions generated by large cities and industrial plants (Likens, et. al., 1979). Even so, it has been encountered in a high altitude Rocky Mountain setting where no direct connection can be made with major emission sources (Lewis and Grant, 1980). But with total project emissions accounting for far less than one percent of the total for the Western United States, it is unlikely that the Mt. Emmons project will noticeably aggravate the problem.

NOISE

Equipment and materials for the project will be brought in by truck. The existing highway configuration requires passing through Gunnison. For most mine and mill locations, truck traffic will also pass through Almont and near the Town of Crested Butte. In addition, worker access and increased population will generate traffic levels well above projected baseline levels. Thus a general increase in traffic-generated noise will result.

CULTURAL RESOURCES

Cultural Resource Impacts - Five types of adverse impacts on cultural resources are possible:

- Destruction or alteration of all or part of the resource. Such direct impacts would affect all Class I and III sites (See Glossary) located in construction areas.
- Isolation from or alteration of the resource's surrounding environment. Such direct impacts could affect all Class I and III sites in or adjacent to construction areas.
- Introduction of visual, audible or atmospheric elements that are out of character with the resource or alter its setting. Such direct and indirect impacts could affect Class I historic sites in the general vicinity of the project. They would not likely affect Class I prehistoric sites, unless they have been developed for educational or recreational purposes, or any Class III sites.
- Neglect of a resource resulting in its deterioration or destruction. Such indirect impacts would affect mostly Class I historic sites. Class III historic sites are generally already deteriorated and Class I and III prehistoric sites are not generally subject to deterioration through neglect. Vandalism resulting from failure to protect avoided resources could result in damage to all Class I and Class III sites.
- Transfer or sale of a property without adequate conditions or restrictions regarding preservation, maintenance, or use. Such indirect impacts could affect all Class I and III sites located in land exchange areas. Direct impacts to cultural re-

sources are most likely to occur during the construction phase of the project with some indirect impacts possible during the operation phase. Impacts due to vandalism from increased use of the area may occur at all stages of the Project. The Forest Service preferred method of cultural resource protection is avoidance. This is effective for most direct and indirect impacts but it is not always practical. It is not possible for land exchange areas where control of the resources would no longer rest with the Forest Service. All land exchanged will require complete survey and all located sites will require mitigation before an exchange can occur. As long as it will not cause artifact deterioration, change or movement, tailings deposition on some Class I and III sites may be viewed as constituting avoidance since it protects and preserves these resources for scientific study at a later date.

Prior to any activity, a cultural resource examination will be performed and a mitigation plan developed in consultation with the State Historic Preservation Office. The Forest Service will require implementation of this plan only on NFS lands.

As an ongoing part of its responsibility to comply with Section 106 of the National Historic Preservation Act, and Section 2(b) of Executive Order 11593, the Forest Service has begun consultation with the State Historic Preservation Officer regarding the National Register status of 663 cultural resource finds located in the Project area. By April 3, 1981 there was agreement on the status of 657 of these locations, with the other evaluations yet to be resolved. Evaluations on additional sites will be submitted in the near future. Of the 657 locations, 19 sites were considered elegible for the National Register of Historic Places, 482 were considered ineligible, and more information is needed to evaluate the remaining 156 sites. Of the sites clearly eligible, 14 could be directly impacted by either Project development or land exchange. The number of sites affected would vary depending on the mill site chosen (AMAX, 1981a, pp. 4-106 to 4-112).

The Forest Service will continue to carry out its cultural resource responsibilities, including the preparation of a proposal for inclusion in a memorandum of agreement that details the actions to be taken to avoid, satisfactorily mitigate, or accept adverse effects on specific sites located on NFS land.

Potential Impacts on the Crested Butte National Historic District - The Forest Service studied the details of the Project's alternatives and prepared an evaluation that included the following conclusions (Forest Service, 1981c).

"On May 29, 1974, Crested Butte was designated a National Historic District because of the presence of many buildings constructed between the 1880's and 1910 which represented its development as a mining community of that time. When the designation was made, 85 percent of the 339 major structures in the town were from this period.

"Since 1974 the Town of Crested Butte has experienced substantial growth due to increased recreation and other activities. Building codes have resulted in new structures which often retain the design elements of the older structures so that the architectural character of the historic district has not changed greatly. However, the cultural character of the district has changed to reflect the new emphasis on recreation.

"Increased population and area use resulting from mining activity should have no effect on the historical or cultural character of the historic district since it only continues the mining tradition which the historic district represents.

"Specific indirect impacts on the physical elements of the district may also be addressed. Estimates of potential population growth in the Crested Butte area show the AMAX project contributing only one-third of expected additional housing units. The present building code should prevent this from causing an effect on the architectural character of the district. Again, the presence of mining families should not change the historical or cultural character of the district.

"Proposed worker access and ore haulage routes will be mostly outside the historic district boundaries. Thus, they should have no effect on the architectural character of the district through damage to structures. Additionally, although the nature of transportation vehicles has changed, the presence of mine worker vehicles and ore haulage vehicles does not change the historical or cultural character of the district.

"The presence of additional powerlines in the vicinity of Crested Butte should produce no significant increase in visual effect over the powerlines already present.

"The Mt. Emmons Project should produce no significant increase in noise level within or adjacent to the historic district. Also, blasting at the mine will produce no structural damage and, thus, no adverse effect on the district.

"In summary, the Mt. Emmons project will have no adverse effect on the Crested Butte National Historic District since it continues the mining traditions the district was designated to represent."

VISUAL RESOURCES

General - Project facilities will generally impact visual resources by introducing new forms, lines, colors, and textures into local landscapes. Major facilities, such as the mine site, mill site, and tailing disposal area, will introduce changes of sufficiently large scale to become dominant features in the local landscape that will not meet inventoried VQO's. They will create 'unacceptable modifications' to the inventoried VQO's and will act as focal points that draw the viewer's attention to the feature and change the surrounding landscape character from generally natural and wild to industrial or urban. Vegetation clearing for building sites, road development, and the stockpiling of topsoil and waste rock, will create patches and strips of light-colored areas that will contrast with the surrounding landscape.

Road, ore haulage, and powerline corridors will introduce lines into landscapes that differ from existing lines, but in most cases it will be possible to meet inventoried VQO's. The forms of buildings, stockpiles, and dams will differ from existing forms. Dust, vehicular exhaust, and other construction-related airborne matter may briefly reduce local visibility, thereby temporarily affecting the scenic quality of the area.

Seasonal landscape changes due to snow cover will also influence the degree of visual impacts. Color and line contrasts may be more evident during winter, particularly in areas where snow is removed. However, snow cover will mask some modifications, thus reducing visual impacts of disturbed areas.

Water vapor emissions from the boilers and mine exhaust will draw attention to the facilities during periods of low temperature and high humidity. Night lighting will also draw viewer attention to the facilities.

As a part of reclamation, structures will be dismantled, disturbed areas graded and revegetated, and materials removed or buried. Residual visual impacts of the project will be the mine and mill benches, the tailing dam and diversion canals, the potable water reservoirs, the mill water make-up reservoir, roadways selected to remain in service, and subsidence on Mt. Emmons.

Population growth resulting both naturally and from the Project's influence will require new housing which will likely involve the expansion of existing communities and the creation of new housing developments in less central locations. This growth will, to some degree, diminish the existing rural character of the landscape, but it will not alter the character of the surrounding mountainous terrain.

Subsidence - Extraction of the Mt. Emmons ore deposit by the proposed method of panel caving (Alternatives 2-5 and 7) will lead to subsidence at the surface, but some uncertainty exists regarding the magnitude of the impact. The angle at which subsidence will work laterally from the mined areas to the surface is a function of rock mechanics and existing patterns of weakness. This angle is expected to fall in the range of 45-60 degrees. Figure 4-1 contains cross sections through Mt. Emmons showing these two caving angles. Figure 4-2 shows where the 45° caving angle intersects the surface, as seen from the towns of Mt. Crested Butte and Crested Butte. The depth of subsidence will depend on how much more volume is occupied by the caved rubble compared to its volume in place prior to subsidence. A reasonable estimate for Mt. Emmons is about 15 percent. At this volume increase, the average depth of subsidence at a 45° caving angle will be about 52 feet, while at 60° the average depth will be about 109 feet. The surface will be irregular, with subsidence over the ore body's edges being greatest.

The greatest amount of subsidence will occur over the south edge, where depths may reach 300-600 feet. The unaffected lower slopes of Mt. Emmons will screen most of the cavity from view.

Subsidence will occur gradually. It will begin an indeterminate number of years following the start of mining and will continue for many years following closure.

The ultimate subsided surface is expected to involve about 434 acres, although under low probability worst-case conditions it could cover as much as 900 acres. The surface will resemble a typical alpine boulder field in texture, but will differ in color due to the freshness of the rubble. Form and line will not resemble typical boulder field terrain because instead of resting in a valley it will sit atop the Mt. Emmons topographic feature. Scarps a few hundred feet high could mark the boundaries of both the intermediate and the ultimate subsidence zones. A natural appearance is not expected to evolve for some time. Inventoried VQO's will not be met.

Given that mining takes place, subsidence could be prevented by leaving pillars for support. (Alternative 6)

OUTDOOR RECREATION

In general, local population growth resulting from the project will lead to an increase in recreation use in the upper Gunnison Basin. But because most of the use will come from people who are not local residents, the influence of the Mt. Emmons project is expected to be minor. It will usually be masked by the external pressures generated by overall regional and national population growth.

For those specific types of recreation that receive a relatively low contribution from local users (such as hiking, hunting, developed camping, and boating), project-related impacts may be so minor that they are negligible. But for those types that receive a proportionately greater local share, the impacts will be more noticeable. Downhill skiing and fishing are prime examples of this. Figure 4-3 indicates that by 1994 the 20,000 TPD production rate will increase downhill skiing by 11 percent--and dispersed fishing by 18 percent--over projected baseline levels. These increases may have a negative influence on recreation quality, but the degree of influence will depend on the downhill skiing capacity in existence at that time, and on the geographic distribution of fishing use.

Downhill skiing capacity will keep up with local skier needs. Crested Butte Ski Area has an approved Master Plan capacity of 6,200 skiers-at-one-time. If built to this capacity and used fully during 75 percent of the operating season, there would be 651,000 skier days available. This equals 298,375 visitor days. The demand for skiing from non-residents will have a much greater effect on ski area growth than will local pressures. Further expansion of the ski area is also possible because Snodgrass Mountain has been designated as a site suitable for more detailed

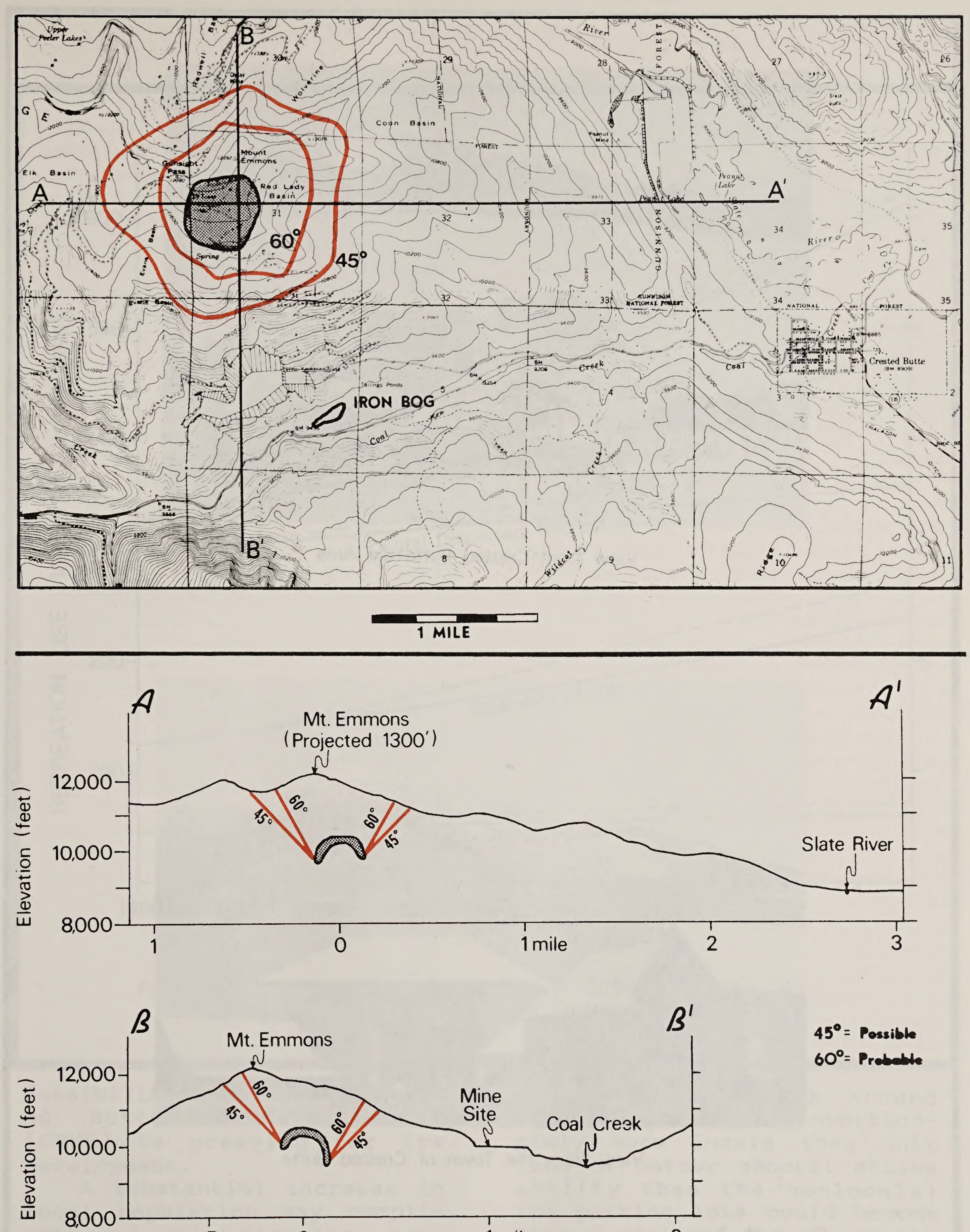
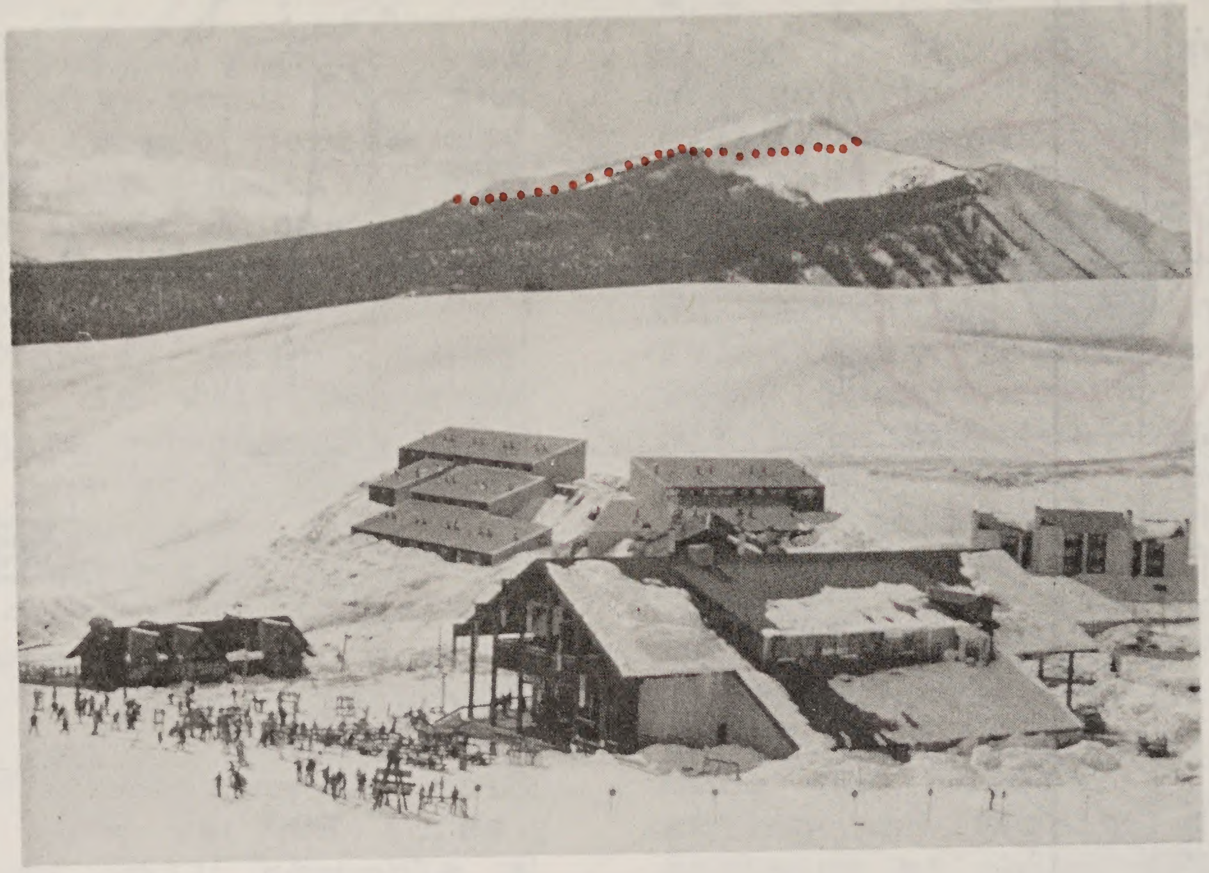
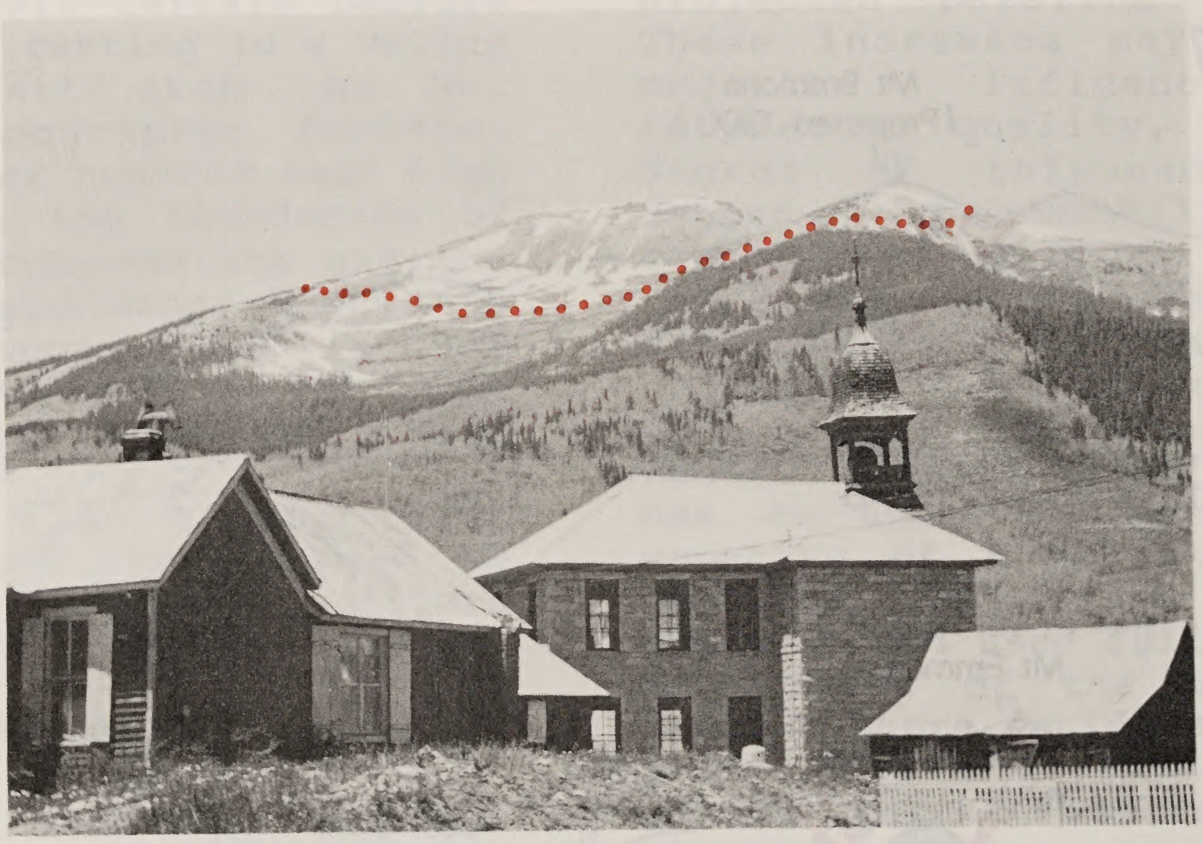

B
A
A'
B'
Mount Emmons
Red Lady Basin
Gunsight Pass
Elk Basin
Evans Basin
Coon Basin
Spring
60°
45°
IRON BOG
Tailings Ponds
Coal Creek
Peanut Lake
Peanut Mine
Slate River
Crested Butte
GUNNISON NATIONAL FOREST
Upper Peeler Lakes
Redwell Basin
Wolverine Basin
Wildcat Trail
Ridge
1 MILE
Mt. Emmons
(Projected 1300')
Slate River
Elevation (feet)
12,000
10,000
8,000
1
0
1 mile
2
3
60°
45°
Mt. Emmons
Mine Site
Coal Creek
.5
45° = Possible
60° = Probable

Figure 4-1 Projected Subsidence Boundaries



View from Crested Butte Ski Area.



View from the Town of Crested Butte.

Figure: 4-2

MAXIMUM LIMIT OF SUBSIDENCE ON MT. EMMONS. PORTIONS OF THE MOUNTAIN ABOVE THE DOTTED LINE WILL BECOME RUBBLE BUT WILL NOT DROP APPRECIABLY

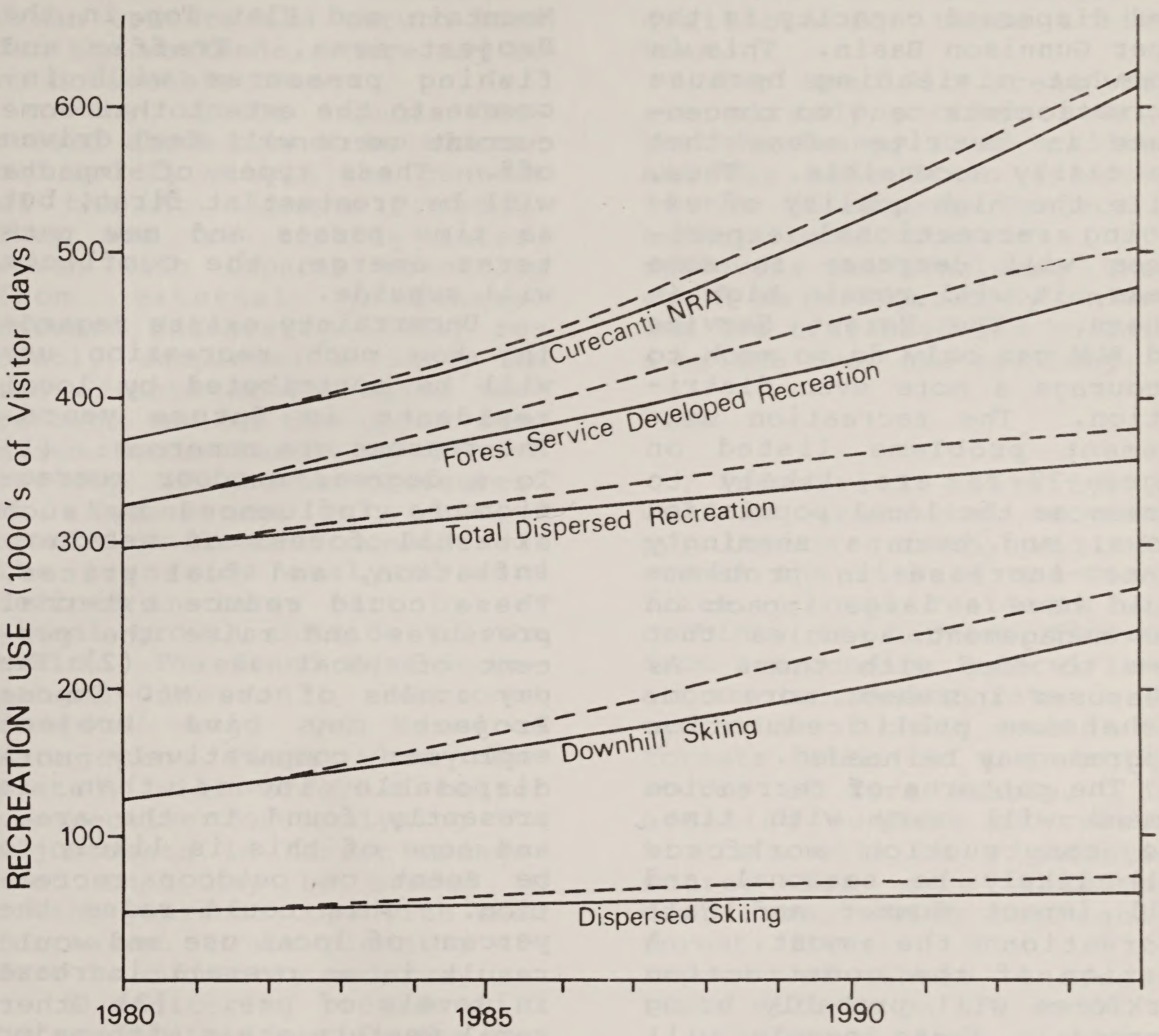


Figure: 4-3 OUTDOOR RECREATION AT 20,000 TONS PER DAY
(Solid lines = without Mt. Emmons. Dashed lines = with Mt. Emmons.)

feasibility studies and Crested Butte Mountain Resort (CBMR) is pressing for its development.

A substantial increase in local population may complicate ski area planning, however. CBMR is aiming at a local:nonlocal ratio of 20:80, and is designing its ski runs and base facilities around this figure. With proportionately more locals than this (and of better general skiing ability than the nonlocals) the parking lots could become overcrowded and the expert ski runs could get too much pressure.

The discussion in Chapter 3 on Outdoor Recreation indicates a large amount of unused dispersed capacity in the upper Gunnison Basin. This is somewhat misleading because recreationists tend to concentrate in favorite areas that are easily accessible. Thus, while the high quality of existing recreational experiences will decrease in some areas, it will remain high in others. The Forest Service and BLM can only do so much to encourage a more even distribution. The recreation management problems listed on pages 72-73 are likely to worsen as the local population grows, and even a seemingly minor increase in problems could have a large impact on the management agencies that have to cope with them. As pressures increase, more comprehensive public education programs may be needed.

The patterns of recreation demand will vary with time. The construction workforce will likely be seasonal and will impact Summer and Fall recreation the most. A portion of the construction workforce will probably bring campers. These people will sometimes want to park them at undeveloped sites near their work areas. They may also use campgrounds for this purpose, which could lead to overcrowding. The construction workforce is expected to favor the consumptive forms of recreation such as boating, hunting, and four-wheel driving. The production workforce is expected to follow recreation patterns more in tune with current residents.

Some traditional recreation patterns will be altered. New groups of hunters will find and use campsites known only to long-time users. Such places exist on Red Mountain and Flat Top in the Project area. Traffic and fishing pressures will increase to the extent that some current users will feel driven off. These types of impacts will be greatest at first, but as time passes and new patterns emerge, the conflicts will subside.

Uncertainty exists regarding how much recreation use will be contributed by local residents in future years. The reasons are numerous: (1) To a degree, outdoor recreation is influenced by such external forces as weather, inflation, and fuel prices. These could reduce external pressures and raise the percent of local use. (2) The pay scales of the Mt. Emmons Project may give Project employees comparatively more disposable income than is presently found in the area, and some of this is likely to be spent on outdoor recreation. This could raise the percent of local use and would result in an overall increase in levels of use. (3) Other rural western areas with major industrial projects have experienced increases in four-wheel drive use and other high-cost forms of recreation such as boating. A similar pattern is expected here, but the degree of any problems that result may not appear as great as elsewhere because of the problems that already exist in the area. (4) The tendency of the construction workforce to recreate locally cannot be predicted with confidence. If the workers move into the area for the entire Summer, a surge in the high-cost forms of recreation can be expected. If most of the workers come from Colorado's urban centers and return home for the weekends, there may be no noticeable change.

Many of the impacts discussed above cannot be addressed solely within the context of the Mt. Emmons Project. They are too tightly interwoven with impacts resulting from external pressures. Harvard University (1981) recently completed a study on the effects of increased recreation use in the upper Gunnison Basin resulting from a variety of growth pressures. Mt. Emmons was only one of several influences considered. The scenarios analyzed were defined in large part by regional growth outside of the basin. The Grand Mesa-Uncompahgre-Gunnison National Forests' Land and Resource Management Plan, when completed, will offer a better perspective for analyzing the adjustments in forest management that may be needed in coming years to cope with such increases. This planning effort is currently underway.

A monitoring program will be needed to identify the nature and location of increasing recreational activities. This would assist agencies in planning specific management changes designed to accommodate increasing recreation pressures. In addition, public information programs such as recreation contact points and the placement of signs would help incoming recreationists to know where recreation opportunities are to be found and where Project facilities are located.

If subsidence occurs, the upper portions of Mt. Emmons will become unsafe for hiking and four-wheel driving, and the area will no longer be available for those activities.

Two specific areas that are already problem sources are the Swampy Pass trailhead and the Lake Irwin spillway. If the Mt. Emmons Project is built, local pressures could aggravate the problems. These could be mitigated by enlarging the trailhead and building a bridge over the spillway.

FIRE

Industrial activity, as well as associated secondary population growth, will increase the risk of man-caused fires. Local residents will continue to harvest firewood from surrounding Federal lands at an increasing rate. The operation of chain saws in the forests will be a potential source of fire starts. Increasing numbers of recreationists will be a potential source for more abandoned campfires, which may ignite forest fires. Most of the impact of these increased risks will be on NFS lands.

Increased fire risks can be partially mitigated through: (1) public information programs, (2) law enforcement, (3) planning and monitoring of activities under permit or contract, and (4) offering public services such as chainsaw spark arrestor inspections and managed firewood collection areas.

TRANSPORTATION

Traffic will increase in the Gunnison Basin under all alternatives. Increases will be greater under Alternatives

2-7. Alternative 1 (No Action) traffic conditions are projected in Table 4-4. The major traffic increases will occur in the City of Gunnison and along roads to the mine and mill sites.

A comprehensive analysis of transportation system impacts was completed by BMML (1981b, Section 10.5). The following discussion is derived from that analysis.

The mine site will be the destination for many vehicles. If car pooling is used and vehicles average three occupants, then the average daily traffic added to Colorado 135 by mine workers will be approximately 400, 1,000, and 2,000 in the years 1986, 1990 and 2002, respectively.

During the construction phase, truck traffic to both mine and mill will have an impact on general traffic movement. Trucks carrying supplies and aggregate are a major concern. It is estimated that during construction at the mill, as many as 20 inbound trucks per day can be expected, with an average of 10 trucks per day, five days a week.

At full production there will be an average of 210 inbound trucks per month routed to either the mine or the mill, virtually all of them on week days. In addi-

TABLE 4-4 AVERAGE DAILY TRAFFIC VOLUME

Roadway	Miles	Road Type*	Estimated 1980	Estimated 2002 Alt 1	Estimated 2002 Alts 2-5	Capacity for Level of Service C
Highway 135: - Ohio Creek to Almont	19.8	A	1,815	3,030	5,363	4,930
- Almont to Crested Butte	9.2	CC	1,022	1,590	Alts. 2-4 3,137	4,930**
Ohio Creek:						
- Intersection 135 to Gage Station	9.2	CC	300	850	1,020	1,000
- Gage Station to Castle Creek vicinity	4.6	CC	225	500	630	500
- Castle Creek to Kebler Pass Road	9.0	CC	100	300	350	260
Antelope Creek	1.9 1.8	CC L	100	500	Alts. 2-7 500	0-350
Jacks Cabin	4.3	C	50	350	350	0-250
Spring Creek	1.9	L	275	675	675	500
Taylor River	19.0	C	540	940	940	600
Kebler Pass Road:					Alts. 2-4	
- City Limit Crested Butte to Pavement End	1.2	CC	200	400	750	650
- Pavement End to Junction Ohio Creek Road	5.6	C	150	350	350	350
Arrow Gas Company	5.1	L	100	500	Alts. 2-7 500	350
Slate River Road	5.7	L	50	250	250	250
Washington Gulch	2.2	L	120	320	320	350
Gothic Road	3.7	CC	1,250	2,000	2,000	1,000

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*A = Arterial; C = Collector; CC = County Collector; L = Local
**For a section of the road from Almont to Jack's Cabin Cutoff the capacity drops below 500

Source: BMML (1981b, Section 10.5)

TABLE 4-5 CAPACITY vs. PROJECTED VOLUMES

	Highway Segment		
	Ohio Creek to Almont	Almont to Jack's Cabin Cutoff	Jack's Cabin Cutoff to Crested Butte
ADT_c	4,930	435	4,930
ADT_e	9,130	1,750	9,130
Alt. 1			
1986	2,180	1,190	1,190
1990	2,400	1,290	1,290
2002	3,030	1,590	1,590
Alts 2-5			
1986	3,469	2,693	1,600
1990	3,999	3,079	2,340
2002	5,363	3,881	3,496

- - - - - - -

ADT_c = Average Daily Traffic capacity at a service level C.
ADT_e = Average Daily Traffic capacity at a service level E.

Source: BMML: (1981b)

tion, approximately 120 outbound shipments are expected each month. About 30 gravel trucks per day will also use the roads to the work sites.

Tables 4-4 and 4-5 show, for a 20,000 TPD mine (Alternatives 2-5), changes in average daily traffic. The most severe traffic capacity problem will occur on Colorado 135 between Almont and Jacks Cabin Cutoff. In this segment, a service level C will be exceeded by over 3,400 ADT's (average daily traffic) in the year 2002.

Colorado 135 will physically be able to handle the traffic, but it will see a reduction in the level of service during peak times (Table 4-5). Major deterioration of the highway surface can be anticipated. Finally, if the road is not changed from 1979 conditions, vehicle accidents can be expected to increase over No Action conditions by appproximately 35, 54, and 74 accidents in the years 1986, 1990, and 2002, respectively (Table 4-6).

TABLE 4-6 PROJECTED COLORADO HIGHWAY 135 ACCIDENTS

		NO ACTION (Alt 1)						ALTERNATIVES (2-5)					
	SEGMENT LENGTH	ADT			PROJECTED NUMBER OF ACCIDENTS			ADT			PROJECTED NUMBER OF ACCIDENTS		
SEGMENT	(MILES)	1986	1990	2002	1986	1990	2002	1986	1990	2002	1986	1990	2002
Ohio Creek to Almont	7	2180	2400	3003	24	27	36	3469	3999	5363	40	44	54
Almont to Jacks Cabin	3.8	1190	1290	1590	6	7	9	2693	3079	3881	17	20	23
Jacks Cabin to Crested Butte	12.5	1190	1290	1590	21	22	29	1600	2340	3496	29	46	71

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Note: With the safety improvements to be made in 1981 a potential reduction in the number of accidents for either alternative is projected, ranging between 20 and 30%. In addition, the hazard index value should be reduced.

Source: BMML (1981b)

If Chance Gulch is used (Alternative 7), transportation system impacts will be of smaller magnitudes than those described above.

Short-term disruptions of established traffic patterns will occur as a result of construction activities.

In addition, the use of motorized vehicles will increase on local forest roads and in unroaded areas. Under Alternatives 2-7, the construction of new roads to reach power lines, railroads, and other worksites will be attractive for motorized vehicle use. If not controlled, this may hinder reclamation and disturb wildlife.

SOCIOECONOMICS

The following discussion is based on BMML (1981b, Section 12.5).

General

The growth created by the Mt. Emmons Project, when superimposed onto the growth already expected from the tourist and recreation industry, will strain all community elements in Gunnison County. Population buildup will be rapid.

If AMAX's proposed schedules are met, local governments will come under pressure to provide for growth. It has not been determined what specific rate of growth a community can satisfactorily absorb, and beyond which the capacity to cope fails. Recent observers of boom towns estimate the threshold to be somewhere between 6 and 10 percent, but these estimates do not identify what levels of effort and awareness the impacted communities exercised to cope with the growth. Keeping pace with increasing demands for services will be a major task. It can be eased by having a management program geared to assimilate growth.

None of the alternatives will affect citizens' civil rights.

Social Impact

People moving to Gunnison County in response to opportunities in the tourist and recreation industry will likely have values and behavior similar to the existing residents. Problems with their assimilation into the existing society are expected to be minimal because they are part of an existing trend. Their economic purposes are part of the same economic force that has driven growth over the past decade.

People moving to Gunnison County in response to AMAX's employment opportunities may have different values and display different behavior than existing residents, making social integration more difficult. Also the construction and operation workers are also likely to vary from each other in values and behavior.

The construction work force will present requirements different from the operations work force. Minimizing the impact from the construction work force is a major concern. It can ease or compound problems associated with assimilating the operations work force. Conditions that increase social problems associated with the construction work force include:

(1) Lack of family present: the 'bachelor syndrome';

(2) Temporary status: no established roots or community ties;

(3) Lack of things to do besides work: no established social organizations, groups or clubs to serve as outlets for physical and mental energies;

(4) Local resentment over high construction wages and lower wages paid to local residents; and

(5) Local anti-growth animosities: most apt to be directed toward the first newcomers associated with the mine.

The intensity of social problems associated with the operations work force is not expected to be as great as with the construction work force.

Other general social effects of growth focus on service problems associated with people who hear about new jobs, pack up and move to the location of rumored employment. Work may not be available for them or they may lack the skills needed. In many cases they lack the funds to sustain themselves in a tight housing market until they can find work or move on. These transient workers and their families have been an early and continuous strain on social support systems in other rural rapid-growth areas. They could create similar problems in Gunnison County, given the existing housing scarcity and severe winters.

Impacts On Public Services

The public service systems which cause the most concern are initially the same for the operations work force as for the construction work force. The construction period will be complicated by the constant ebb and flow of the work force on a quarterly basis, causing a significant variation in demand for public services.

The public systems where efforts will be most critical are: housing, police, social services, recreation, transportation, schools, sewers, and solid waste. As most of these services are supported from general revenues, financing will be a major issue almost immediately. The general revenues projected to result from the Project's assessed valuation will not be available until the latter part of the 1980's or early 1990's.

Local Economic Impacts

The temporary nature of the construction work force could have an adverse impact on the tourist and recreation economy. Construction workers could consume tourist quarters and lead to a shortage, which could discourage tourists from visiting the area. In addition, tourist volumes could be weakened by social conflicts in public places, by competition for NFS campground sites, and by overcrowding in streets.

On the other hand, overall business volume will increase as the local population grows.

AMAX Costs

Detailed information on AMAX's Project costs is not available. At one time the Bureau of Mines was given access to AMAX's initial detailed feasibility study for verification (Steckley and Lemons, 1980), but those early figures are now obsolete. The estimated 1994 assessed valuation of AMAX's proposal is about $116 million (BMML, 1981a). Based on this, the capital cost will be about $650 million, in 1980 dollars.

Operating costs cannot be estimated reliably using available information.

GEOLOGY

Most Project facilities will involve cut and fill alterations, which will be inconsequential in geologic terms. The dominant geologic impact of the Project will be subsidence resulting from extraction of the ore body (Alternatives 2-5 and 7), which is described on page 115.

An important consideration is the seismic stability of the Project area. In a worst-case event, a major earthquake could rupture the retention structure at any of the locations, with the possible result that some tailing could be carried away with any water that escapes. Because of their closeness to major area streams, the Carbon Creek (Alternatives 5-6) and Chance Gulch (Alternative 7) sites would be more likely to deliver tailing into streams than would the Alkali Creek site (Alternatives 2-4). This could result in severe sedimentation, channel damage, and loss of fishery habitat for an undefinable length of channel. Long-term chemical pollution might also result.

The likelihood of a serious seismic event is low. No recently active fault traces have been mapped in the area, and the general vicinity is not noted for seismic activity (Walsh, 1980c).

More minor, small-scale geologic events that may affect the Project include local slumps, mudflows, and landslides associated with roads and railroads. These would be triggered by undercutting potentially unstable slopes, which are quite common in Mancos Shale terrain. Standard slope stabilization practices should keep the impacts of such slope failures to a minimum. Temporary minor facility damage and water quality degradation would be the usual result.

The above discussion covers most of the alternatives analyzed in the following sections. Those that receive further analysis are: Slate River mine site impacts (page 147), Alkali Creek mill site impacts (page 159), ore haulage to Alkali Creek (page 168), and worker access to Alkali Creek (page 172).

SOILS

The long-term impact on soils is directly related to their potential for reclamation and future productivity. Table 3-9 on page 95 summarizes the reclamation potential of soils in the Project area.

Impacts on soils include wind and water erosion caused by removal of vegetation, loss of productivity caused by a decrease in microorganisms during long-term stockpiling, and loss of productivity caused by excessive compaction during reclamation. Some soils lack sufficient thickness to be removed for stockpiling while others are too rocky to be removed or replaced. Their productivity will be lost. The productivity of soils in the subsidence zone will also be lost.

Because almost all areas disturbed by the Project will be reclaimed (either during or following the productive life of the Project), the long-term impacts on soil resources will be minor.

Secondary impacts on soil resources will occur as a result of increased housing and commercial development, which will disturb or cover soils with buildings and pavement. These impacts can be minimized by managing new development in accordance with local zoning, subdivision, and building regulations.

LAND USES

Timber Production - Commercial forest land will be converted to non-commercial forest or unforested land by clearing or pruning for facility sites and rights-of-way.

Transmission line and railroad access roads could make commercial timber stands accessible for harvest that are economically infeasible today. The alternatives being studied do not offer major opportunities of this type, however.

Grazing - Direct impacts on range use include loss of vegetation (forage) for domestic range livestock. The clearing and revegetation of some areas, such as railroad rights-of-way, can create new forage. Livestock grazing and trailing patterns can change as a result of disturbance at

Project work sites, cleared rights-of-way, and changes in water sources.

Indirect impacts resulting from increased population will include base lands being sold for housing, increased annoyances to ranchers from increased public use, gates left open, and cattle accidentally shot by hunters. Trailing livestock on public roads will become more difficult due to increased traffic. Additional problems can result from stray dogs harrassing and killing livestock. Aggressive dog control regulations can control such problems.

Agriculture - Direct impacts to agriculture can result from lands taken out of production to construct roads, railroads and electrical transmission lines. Only the Alkali Creek mill site (Alternatives 2-4) directly affects private agricultural land. In addition to taking land out of production, many of these facilities can impede agricultural operations. These problems can be significantly mitigated by locating linear facilities along existing fence lines where possible. Some water use will be shifted from agriculture to mining.

Indirect impacts to agriculture will result from bottomland haymeadows being sold for urban or suburban development. Of the estimated 38,000 acres of meadowland in Gunnison County (Gunnison County Chamber of Commerce, 1980), the estimated maximum demand generated by the Mt. Emmons Project for land for urban purposes is 1,200 acres.

Direct impacts on agricultural lands from the Mt. Emmons Project will come from utility and railroad corridors.

Urban, Suburban, Commercial, Industrial - All of the Project alternatives are located to generally avoid communities, population centers, and highly developed areas. When Project facilities do impact residences or communities, the effects may include changes in visual qualities, increases in noise levels, radio or TV interference from electrical transmission lines, and traffic hazards where roads intersect railroads.

An indirect effect from population increase caused by the mining operation will be an increase in land area used for urban, suburban, commercial and industrial purposes. BMML identified a Project-related impact of 600-1,200 acres needed for urban land use associated with a 20,000 TPD mine (Alternatives 2-5 and 7). Differences would be minimal for either a 10,000 TPD (Alternative 6) or 30,000 TPD mine (Alternative 7). Traffic can be expected to increase on all roads.

Special Land Uses - Existing special use sites and areas are identified in Chapter 3.

The operation of the Mt. Emmons mine and mill will introduce direct impacts on the Forest Service to issue and administer new permits and easements for Project facilities. Examples include:

- May 20, 1981: AMAX applied to the Forest Service for an easement across and under NFS lands for the construction, operation and maintenance of an ore haulage railroad system and related facilities.

- March 13, 1981: Gunnison County Electric Association, Inc. applied for a right-of-way authorization to use NFS land for the construction, operation and maintenance of electrical transmission lines designed to serve the Mt. Emmons mining and milling operations as well as other purposes.

Additional applications are likely to be made for uses such as telephone lines and electronic sites.

A hazard common to all construction projects is the destruction of public land survey monuments and private property corner markers.

AVALANCHE HAZARD

An avalanche risk common to all alternatives except No Action (Alternative 1) is the possibility that underground blasting may increase the frequency of avalanches nearby. This may be theoretically true, but the probability of occurance is low. Shock waves from underground blasting will be insignificantly low by the time they reach the surface, and their influence on avalanching will be more a matter of timing than of triggering movement where none would otherwise occur. Risks to human health will be negligible. Individuals venturing into avalanche-prone areas will be far less endangered by subsurface blasting than by their presence in the area.

Shock waves generated during subsidence will have a similar negligible influence on avalanching. As subsidence progresses, the starting zones of some avalanche areas high on Mt. Emmons may be flattened, which would lead to a long-term reduction of avalanche hazard.

MINE SITE

PAGE REFERENCE

Coal Creek. 129
  Site Impacts 129
  Worker Access. . . . 138
Slate River 142
  Site Impacts 142
  Worker Access. . . . 147

COAL CREEK MINE SITE
(Alternatives 2, 3, 5-7)

Coal Creek Mine Site Impacts

Vegetation

General - The Coal Creek mine site could potentially disturb 231 acres of land. Table 4-7 lists this disturbance by vegetation type. Cut and fill slopes, and the topsoil stockpile, will be revegetated beginning in the late construction phases. The mine yard will be ripped, covered with topsoil, and revegetated at the close of the Project.

Threatened and Endangered Species - No threatened or endangered plant species will be affected by constructing a mine site in Coal Creek.

Iron Bog - Fill material for the Coal Creek mine site will be approximately 600 feet upslope from the water perimeter of the Iron Bog. The slopes between the Bog and the toe of the fill average 15

TABLE 4-7. ACRES OF POTENTIAL VEGETATION DISTURBANCE: COAL CREEK MINE SITE

VEGETATION TYPE	Mine Pad	Access Road	Totals
Mountain Grassland		44	44
Subalpine meadow	14		14
Aspen	100	27	127
Engelmann spruce/fir	21		21
Disturbed areas	3	10	13
Sagebrush		10	10
Subalpine willow	2		2
TOTAL*	140	91	231

*All acres are on NFS lands.

percent. Heavy rain storms could deliver sediment to the Iron Bog in sufficient quantities to bury the sundew plants. This can be mitigated by constructing runoff diversions between the fill and the Iron Bog. The mine pad could be redesigned to increase the distance between construction activity and the Iron Bog.

The proximity of construction activities to the Iron Bog increases the risk that accidents could reduce or destroy the sundew population. This possible adverse impact could be mitigated by signing or fencing, locating fire fighting equipment nearby, informing all workers of the sensitive area, and stationing monitoring personnel nearby.

Wetlands - Approximately 2 acres of subalpine willow and meadow vegetation will be buried under the site.

Wildlife

Table 4-8 lists the wildlife habitats that would be lost for approximately 30 to 50 years if the Coal Creek mine site is constructed. This table also shows a comparative index value representing the effect on all inventoried wildlife that may use these habitats. This index, described in Appendix I, is used to compare wildlife impacts between alternatives.

Elk and Deer - About 220 acres of deer and elk summer range will be lost for 30 to 50 years if the Coal Creek mine site is constructed. Noise and human activity, particularly during construction, will cause a much larger loss of summer range. This loss is neither long term nor absolute because some animals will adapt to the Project and use all of the adjacent habitat.

Sage Grouse - No sage grouse habitat would be affected by the Coal Creek mine site.

Threatened and Endangered Species - No threatened or endangered wildlife would be affected by constructing a mine site in Coal Creek.

Aquatic Ecology

Under normal construction and operating conditions and with the mitigation measures being proposed, no significant effects on aquatic ecology are expected. Under worst-case conditions increased sediment levels and accelerated abrasion will reduce benthic macroinvertebrate populations and could increase mortality levels in the brook trout population. The effects related to the worst-case discussion will normally be flushed out of the stream system the following Spring. With supplemental stocking, the ecosystem could approach full recovery in the following year.

The effects of chemical spills, for which there will be some unavoidable risks, will probably have similar effects and duration as the sediment effects.

Energy

Energy consumption and conservation potentials are discussed on pages 107 and 201. Other than related to ore haulage, no outstanding differences in energy consumption were identified.

Water

Sediment is the major concern during construction. It will be delivered to Coal Creek by surface runoff across areas disturbed during earthmoving activities. The two times when this will be most likely to occur are during the Spring snowmelt and during Summer rainstorms.

The mitigation measures in Appendices A and B will minimize the amount of sediment reaching Coal Creek. However, even settling basins that effectively remove the bulk of the sediment will dis-

TABLE 4-8. INDEX OF POTENTIAL WILDLIFE IMPACTS:
COAL CREEK MINE SITE

Habitat Type	Acres Disturbed	Index of Total Wildlife Impact*
Riparian	2	7.22
Aspen	127	260.35
Spruce-fir	21	36.12
Dry meadow	58	107.36
Sagebrush	10	20.59
Disturbed areas	13	NA
TOTAL	231	431.64

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*Larger index numbers mean greater adverse impacts to the inventoried wildlife species expected to use these habitats.
NA = Not Applicable
Appendix I discusses index development.

charge finer-sized particles. These should not cause damage to either the channel or the existing fishery, but with the Town of Crested Butte's intake lying downstream of the mine site, it can be anticipated that some project-generated sediment will enter the intake. An effective means of remedying this is to route all settling basin discharges to a point below the intake, which is about two miles away. (This may require a National Pollution Discharge Elimination System permit from the Colorado Department of Health.) Assuming that all waters impacted by Project activities can be handled in this way, mine site conflicts with the municipal watershed appear avoidable.

In the event of runoff exceeding the capacity of the erosion and sediment control system, a worst-case event would follow. This would raise suspended sediment concentrations in Coal Creek to an unusually high level for the duration of the event and possibly lead to increased turbidity in the Town's water supply for a limited period of time afterwards. Damage to the Coal Creek channel caused by high flows may be aggravated through accelerated abrasion by the additional sediment, which could lead to a more prolonged period of degraded chemical and biological quality. If this were to occur, additional water treatment measures may become necessary for the Town of Crested Butte's water system--or another source may have to be developed--in order to insure a safe and adequate water supply. A number of potential alternative sources have been identified (Black & Veatch, 1980).

Even without the mine site, there is a natural risk that a major runoff event might alter the stability of Coal Creek's channel and lead to water quality deterioration.

During operation of the mine, the risk of sediment loadings will be considerably reduced when compared with the construction phase. Runoff generated upslope from the mine site will be routed around and/or under the mine site. These waters should not be adversely affected. Runoff generated by snowmelt and rainfall on the site will be routed through a treatment facility that includes six 2.75 acre-foot settling basins which will remove most suspended solids and help buffer flood peaks. This buffering effect may prove to be a minor positive impact during summer rains because the stored waters can be released once flows have subsided in Coal Creek.

During construction and operation, there will be a risk that spills of oil, fuel, and other liquids may reach Coal Creek and possibly enter the Town of Crested Butte's water system. AMAX will dike the areas where these materials are stored and develop contingency plans for accidental spills. Such steps should minimize risk.

Groundwater will be slightly impacted during construction and operations. Some groundwater movement takes place through the surficial materials that blanket much of the mine site area, and a readjustment of flow patterns will take place as a result of cutting and filling.

Following reclamation, the quality of surface water flowing from the area should approximate that of present conditions. The rate of run-off will likely be reduced because of the flat area left behind.

Groundwater impacts after reclamation will be similar to those discussed above, except that more infiltration will be possible once the surfacing has been removed.

Air

Fugitive dust will be emitted during construction and will be minimized using the controls listed in Appendices A and B. The Colorado Air Pollution Control Division has issued permits for the emission levels shown in Figure 4-4. Additional fugitive dust will be emitted during operations, shown in Figure 4-4. Fugitive emissions will generally drift in an easterly direction, and some dust may enter Coal Creek.

Point source emissions will take place during operations. Emission sources are listed in Table 4-9, and emission levels are listed in Table 4-10. Resultant maximum concentrations are listed in Table 4-11. National Ambient Air Quality Standards will be met. Permits have been issued by the APCD covering these emissions.

Predicted emissions and concentrations of Colorado designated hazardous pollutants are listed in Table 4-12. Standards will be met.

Noise

Maximum A-weighted noise levels during construction activities will reach 90-95 dB. Heavy equipment such as bulldozers, compressors, etc., will be the main noise sourc-

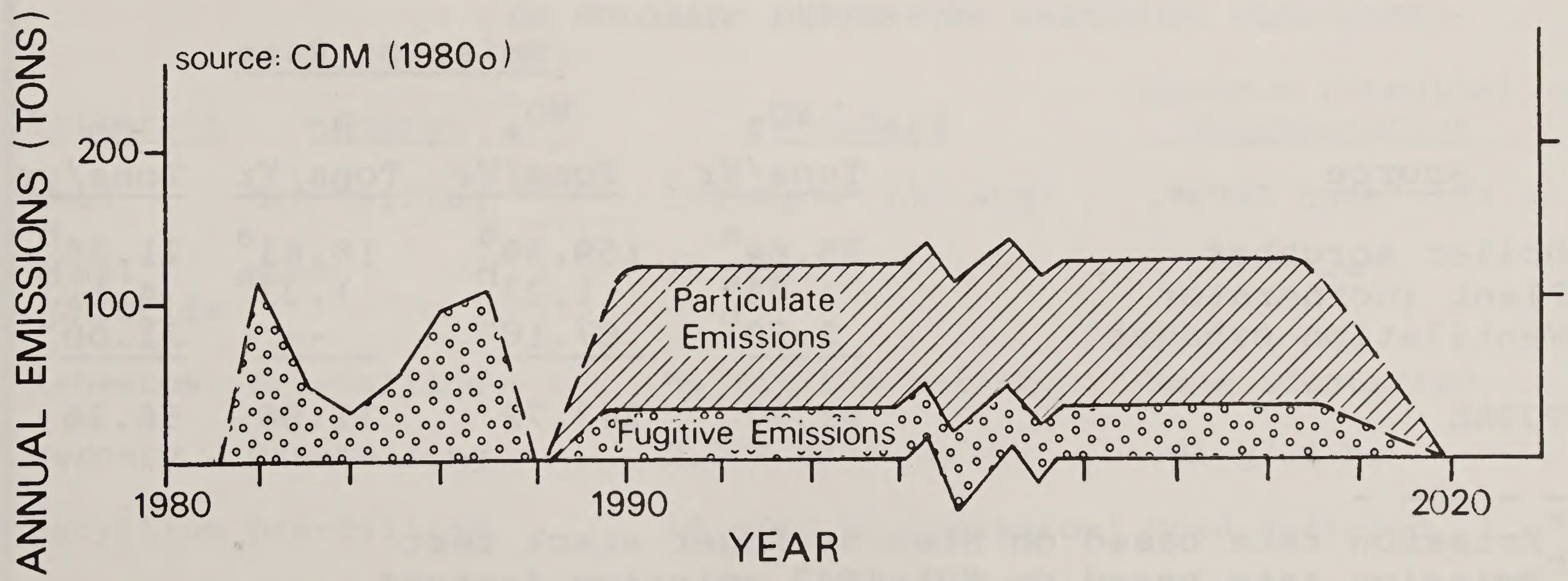

Figure: 4-4 PARTICULATE AND FUGITIVE EMISSIONS FROM THE COAL CREEK MINE SITE

TABLE 4-9 MINE SITE EMISSION SOURCES

Fugitive Emissions

- Emergency coal storage pile
- Coal dumping to hopper
- Aggregate storage pile
- Aggregate dumping
- Moving aggregate
- Scraper operations
- Wind erosion
- Haul roads
- Support vehicles
- Road repair
- Watering trucks

Point Source Particulate Emissions

- Ventilation exhaust
- Boiler
- Concrete batch plant
- Incinerator
- Timber framing shop

Point Source Gaseous Emissions

- Boiler scrubber
- Plant incinerator
- Ventilation Exhaust

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Source: CDM (1980o)

TABLE 4-10. POINT SOURCE GASEOUS EMISSIONS FROM MINING FACILITIES

	Emission Rate			
Source	SO_2 Tons/Yr	NO_x Tons/Yr	HC Tons/Yr	CO Tons/yr
Boiler scrubber	35.04[a]	159.39[a]	10.63[a]	21.25[b]
Plant incinerator	1.03[b]	1.23[b]	1.23[a]	4.11[b]
Ventilation exhaust	5.20[b]	87.10[c]	--	31.00[c]
TOTAL	41.27	247.72	11.86	56.36

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[a] Emission rate based on Stearns-Roger stack test

[b] Emission rate based on EPA-AP42 emission factors

[c] Emission rate based on CDM (1980p)

Source: CDM (1980o)

TABLE 4-11. MAXIMUM CONCENTRATIONS OF POINT SOURCE EMISSIONS: COAL CREEK MINE SITE

Pollutant	Maximum Predicted Concentration (ug/m^3)	Direction to Maximum Concentration	Distance from Site Center to Maximum Concentration (km)	State/ Federal Standard (ug/m^3)
TSP				
Annual	15.2	ENE	1.0	60
24-hour	47.6	ENE	2.0	150
SO_2				
Annual	9.9	ENE	1.0	80*
24-hour	33.1	ENE	1.0	365*
3-hour	129.0	NE	1.0	1,300*
NO_x				
Annual	47.2	ENE	2.0	100
CO				
8-hour	37.8	ENE	1.5	10,000
1-hour	204.6	NE	1.0	40,000

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*Federal standard only
Source: AMAX (1981a)

TABLE 4-12. MAXIMUM POTENTIAL AMBIENT CONCENTRATIONS OF COLORADO DESIGNATED HAZARDOUS POLLUTANTS

Pollutant	Source	Standard	Maximum Potential Concentration
Lead	Ore-Tailing	1.5 ug/m^3 (mo avg)	.00045 ug/m^3 (24 hr)
Vinyl Chloride	None	10 ppm	--
Asbestos	Ore-Tailing	No visible emission	None identified
Mercury	Ore-Tailing	2,300 g/24-hr avg	.01 g/24 hr
Beryllium	Ore-Tailing	10 g/24 hr (emission)	None detected
Hydrogen Sulfide	Reagent mixing (upset condition)	142 ug/m^3 1-hr avg	Limited releases during emergency upsets

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Source: CDM (1980o)

es. Noise will also come from blasting in the access drifts during the first few months of drift advance. Under worst-case conditions these noises will not drop to background levels for about two miles. This would generally occur with the assistance of atmospheric reflection, which is uncommon. AMAX intends to avoid blasting during these conditions in order to minimize noise impacts on the Town of Crested Butte. See Appendix A.

During operation, which will be continuous during a 5-day week, fan noise from the ventilation system will be the dominant noise at the site. Maximum day-night noise levels expected at the property boundary will reach 66 dB, but with distance they will drop. At the Lake Irwin Lodge and in the Town of Crested Butte these noises will be well below background levels even at night.

Underground blasting will not be heard on the surface.

Cultural Resources

The Coal Creek mine site is, in terms of potential cultural resource impacts, the least sensitive of all mine site or mill site alternatives analyzed. The potential cost to mitigate direct impacts at this site would be less than $500.

Visual Resources

During construction and operation, the site will create form, line, color and texture contrasts with the surrounding landscape, and the site's size will make it a dominant feature in the Coal Creek valley. It will not meet inventoried VQO's.

Following reclamation, color and texture contrasts will largely be reduced and the site will differ from its surroundings only in terms of form and line, which may remain strongly noticeable unless the bench's edges are warped and rounded. It may be possible to meet inventoried VQO's if this is done.

Outdoor Recreation

Hiking conflicts will be minor because of the site's low elevation. Interference with fishing along Coal Creek is not expected.

Following reclamation, the site could possibly be used as a base area to support downhill skiing on Mt. Axtell.

Fire

The fuels surrounding the Coal Creek mine site consist primarily of aspen with small interspersed parks and spruce-fir stands. A normal fire run upslope from the mine site would reach timberline and sparse fuels within 1/4 to 1/2 mile. The fire hazards on this site are considered low to moderate.

Besides the mine development, the highest values at risk are the municipal watershed and the Iron Bog.

Transportation

See pages 121 and 140.

Socioeconomics

General - Socioeconomic impacts are not considered sensitive to mine site location.

AMAX Costs - See this discussion under the Slate River site on page 146.

Geology

No significant geologic hazards exist at the Coal Creek mine site.

Soils

Soils subject to impact at this site are: Shadow, Blanca, and Gateview. Shadow and Blanca are rated as having high sensitivity to impact. Gateview soils are normally rated as important although those present in the area are not used for agriculture.

Shadow soils comprise 15 acres of the mine site. The Shadow soils are stony, shallow, have rockland inclusions and have a poor reclamation potential.

Blanca soils comprise 105 acres of the mine site. The Blanca soils are cobbly, stony, and erosive. Reclamation potential is fair.

Gateview soils comprise 8 acres of the mine site. The Gateview soils have favorable construction material characteristics and reclamation potential.

Land Uses

General - Existing uses in the mine site area will be replaced by industrial use. About 18 AUM's of grazing capacity in the Coal Creek Cattle Allotment will be lost, but the allotment is not currently being used. No regulated commercial forest land will be affected, and timber yields will not be significantly reduced.

Existing Special Uses - Construction of the Coal Creek mine site will change the area where the Standard Metals Corporation access road crosses Mt. Emmons. Other uses of the mine site area include: Several oil and gas leases on which exploration activity has not been initiated and, a buried cable owned by Mountain States Telephone and Telegraph Company and a powerline owned by Gunnison County Electric Association (both serving AMAX facilities at the Keystone Mine site). Where these uses are under permit or lease on NFS land, agreement on facility relocation, condition, and use will have to be reached between the permittee and AMAX, with final approval of the Forest Service.

Secondary impacts from mine site construction could change conditions in research areas on Coal Creek used by Rocky Mountain Biological Laboratory. Mitigation effectiveness will determine the degree of biological change induced by constructing the Coal Creek mine site.

Future Special Uses - If a land exchange for areas surrounding the mine site is not consummated, the Forest Service could expect future applications for mining-related uses that occur off of mining claims. Administrative impacts of reviewing and administering these permits would increase workloads on the Taylor River Ranger District.

Avalanche Hazard

Avalanche hazards are low at this site (Mears, 1980). Although high avalanche hazards are widespread in the vicinity (Figure 3-14), the site is below the runout zone of avalanches generated at the head of Evans basin.

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Worker Access to the Coal Creek Mine Site

Vegetation

General - Vegetation types disturbed by access road construction are listed in Table 4-7 on page 130. Cut and fill slopes will be revegetated beginning with the late stages of construction.

Threatened and Endangered Species - No threatened or endangered plant species will be affected by constructing the mine site access road.

Wetlands - Reconstruction of Colorado 135 and construction in the Coal Creek drainage could disturb a maximum of 2 acres of riparian wetlands and 24 acres of irrigated hay meadow. The Carbon Creek variation of an Ohio Creek route could disturb 4-9 acres of riparian wetland and 15 acres of irrigated hay meadow. An upper Ohio Creek route could disturb 2-4 acres of riparian wetland and 13 acres of irrigated hay meadow. Much of the impact in irrigated hay meadow for the Ohio Creek route will be related to reconstruction of the Ohio Creek road.

Wildlife

The effects on wildlife of constructing the mine access road are incorporated in the mine site discussion on page 130.

Aquatic Ecology

The effects on aquatic ecology of constructing the mine access road are incorporated in the mine site discussion on page 131.

Energy Requirements

Estimates of annual energy consumption for worker transportation under three different scenarios are shown in Table 4-13 on page 141.

Water

Reconstruction of existing highway systems will have negligible impacts on water quality except for temporary sediment loadings at stream crossings. Most reconstruction will be on relatively flat terrain.

Construction of a Coal Creek crossing for the Crested Butte bypass will require a Section 404 Dredge and Fill Permit from the Army Corps of Engineers. If a western access is used, construction of crossings over Ohio Creek or Carbon Creek would probably also require a Section 404 Permit.

Road construction in the Coal Creek drainage will generally occur on sloping terrain and there will be a risk of sediment entering the stream above the Town of Crested Butte's water intake. This can be avoided by routing all impacted waters to a discharge point below the intake.

Runoff flowing through the access system's ditches during operations will carry sediment. Routing this water to a discharge point below the intake can avoid conflicts with municipal water supply.

Constructing a diversion ditch below the main access road and designing it to discharge into Coal Creek below the intake will protect the municipal water supply from accidental toxic spills.

After mine closure, impacts on water will resemble those occurring while operations are underway.

Air

Minor fugitive emissions will accompany construction.

Noise

Noise impact estimates for mine traffic were based on 800 employee vehicle trips (400 each way) and 10 heavy trucks per day. Along Colorado 135 this volume will increase noise levels in the Town of Crested Butte by 4 dB, and by 2 dB in Almont and Crested Butte South (Mirabelli, 1980). These impacts will occur in a regular daily pattern based on shift changes. Slightly greater impacts will occur during construction due to a larger number of trucks bringing in supplies. If all employees drive their own vehicles, noise levels will be somewhat higher. Conversely, if most workers used car pools and/or mass transit, the levels will be somewhat lower.

Truck traffic on the bypass around the south side of the Town of Crested Butte may produce increased noise. The logical point for the bypass to cross Coal Creek is in or near the southwest corner of the Town. This area is within a few hundred feet of existing houses. No land barriers are present to screen roadway noise, and consequently this part of town is likely to be more affected by traffic noise than the rest of the Town.

If mine-related traffic passed through the Town, noise impacts will be substantially higher.

Along an Ohio Pass route impacts would be similar, but no communities would be affected. Some residential areas along the Ohio Creek valley would be impacted due to estimated A-weighted noise levels of 69 dB for light vehicles and 79 dB for medium and heavy trucks at a distance of 100 feet from the roadway.

Cultural Resources

No adverse effects on cultural resources have been identified. Surveys will be conducted after the final location is determined. If cultural resources are located during construction, they will be evaluated and mitigation consistent with their value will be determined.

Visual Resources

Once Colorado 135 has been upgraded to handle increased traffic, it will not look much different than it does now. The bypass around the Town of Crested Butte will introduce a strong linear feature along the bench south of town, but this will not be visible from town except near its approach, the Coal Creek crossing. In the Coal Creek valley, the access road will introduce visual contrasts, as discussed on page 114.

A paved Ohio Pass route, on the other hand, would bring with it much stronger visual contrasts than the existing graveled road has already created. If a Carbon Creek variation were used, a strong linear feature would be introduced on the north side of Carbon Peak where none currently exists.

Outdoor Recreation

The eastern access alternative will not interfere with fishing on Coal Creek because the road will be upslope from the valley bottom.

A western access would create more impacts. Construction of an all-weather paved road over Ohio Pass would probably bring more recreation traffic into the Ohio Creek-Kebler Pass area and may lead to more day use in adjacent areas. The Lake Irwin campground may receive more use. The Swampy Pass trailhead may need to be expanded. It is a major starting point for hiking into the West Elk Wilderness and is already experiencing problems with overcrowding.

Fire

The degree of fire risk will vary depending on final road and reclamation designs. Also, fire prevention education can be incorporated into employee training.

If a fire did start, the current fuel hazard along most of the road right-of-way consists of subalpine parks with scattered aspen stands. These fuels can have low to extreme rates of spread, depending on the season of the year, and low resistance to control.

The access route using the Crested Butte bypass would have considerably less exposure to hazardous fuels than the Ohio Creek route.

Transportation

Many transportation related impacts are discussed on page 121. Construction of a bypass around the south side of the Town of Crested Butte could generate many changes for the Town. The bypass could eliminate all Kebler Pass traffic on White Rock Avenue. Depending on final design, the bypass could make it inconvenient for Kebler Pass and mine-related traffic to enter the Town.

Possible traffic volumes are identified in Table 4-13.

Socioeconomics

General - If the East River access route is used, some employees can be expected to stop off in the Town of Crested Butte before driving home. This will improve some businesses, but it could also lead to occasional social conflicts. Occasional traffic accidents could also result.

The above impacts will be less likely to occur if the Ohio Creek route is used, but some employees will probably continue to use Colorado 135.

AMAX Costs - Besides requiring substantially more reconstruction and associated costs, higher snowplowing costs would be incurred in keeping the Ohio Creek route open over Ohio Pass.

Land Use

The effects on land use of constructing the mine access road are incorporated in the discussion beginning on page 137.

Avalanche Hazard

The bypass around the Town of Crested Butte and the access road in Coal Creek pass through areas of moderate hazard (Mears, 1980). The Carbon Creek-Ohio Pass route passes through areas of high hazard.

TABLE 4-13 WORKER TRANSPORTATION ENERGY CONSUMPTION: BOTH MINE SITES

Transportation Mode	Project Phase (4)	Autos or Trips/Week (5)	Million Btu/Year (6)
Individual vehicles (1)	Construction	2,024 - 2,684	32,023 - 42,466
	Operation	4,702 - 6,262	74,394 - 99,076
Car Pooling (2)	Construction	1,342	21,233
	Operation	3,152	49,870
Bussing and Car Pooling (3)	Construction	464	10,023
	Operation	1,106	24,063

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(1) Number of persons per vehicle 1.5 - 2
(2) Number of persons per vehicle 3 (average)
(3) 70% reduction due to bussing, remainder car pooling 3 persons/car
(4) Construction year 1986, operation year 2002
(5) Construction phase and operation phase = 5 (day shift + swing shift + graveyard shift) + 2 (weekend + graveyard + swing shift)
(6) Construction and operation = 52 weeks/year
Travel distance = 31 miles worst-case
Vehicle fuel consumption = 127,600 Btu/gallon ÷ 13.0 miles/gallon (average).

Source: BMML (1981b, Table 10.5-6)

SLATE RIVER MINE SITE
(Alternative 4)

Slate River Mine Site Impacts

Vegetation

Slate River mine site construction could potentially disturb a total land area of 303 acres. Table 4-14 describes potential land disturbance by vegetation type.

Threatened and Endangered Species - No threatened or endangered plant species will be affected by constructing a mine site on Slate River.

Wetlands - Approximately 47 acres of riparian willow, subalpine willow thickets, and wet sedge will be buried under the site. Reconstruction of Colorado 135 and construction to the site could disturb a maximum of 2-4 acres of riparian willow and 25 acres of irrigated hay meadow.

Wildlife

Table 4-15 lists the wildlife habitats that will be lost for approximately 30 to 50 years if the Slate River mine site is constructed. This table also shows a comparative index value representing the effect on all inventoried wildlife that may use these habitats. This index is used to compare wildlife impacts between alternatives. Total wildlife impacts are greater at the Slate River site than at the Coal Creek site.

TABLE 4-14. ACRES OF POTENTIAL VEGETATION DISTURBANCE: SLATE RIVER MINE SITE

	Mine Site		Access Roads		Totals	
VEGETATION TYPE	NF	PVT	NF	PVT	NF	PVT
Mountain Grassland		46	20	32	20	78
Wet Sedge				1		1
Sagebrush				16		16
Subalpine willow		26				26
Aspen	31		27		58	
Spruce-fir	13				13	
Hay meadow				5		5
Disturbed area		53		13		66
Riparian willow		16		4		20
Ownership Totals	44	141	47	71	91	212
Totals	185		118		303	

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NF = National Forest System land; PVT = Private land

TABLE 4-15 INDEX OF POTENTIAL WILDLIFE IMPACTS:
SLATE RIVER MINE SITE

Habitat Type	Acres Disturbed	Index of Total Wildlife Impact*
Riparian	47	169.67
Wet Meadow	5	8.5
Aspen	58	118.9
Dry Meadow	98	163.66
Spruce-fir	13	22.36
Sagebrush	16	23.84
Disturbed area	66	NA
	303	506.93

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*Larger index numbers mean greater adverse impacts to the inventoried wildlife species expected to use these habitats.
NA = Not Applicable
Appendix I discusses index development.

Elk and Deer - About 240 acres of deer and elk Summer range will be lost for 30 to 50 years if the Slate River mine site is constructed. Noise and human activity will cause a short term loss of additional summer range.

Sage Grouse - No sage grouse habitat will be affected by the Slate River mine site.

Threatened and Endangered Species - No threatened or endangered wildlife will be affected by constructing a mine site on Slate River.

Aquatic Ecology

The aquatic effects discussed on page 131 for the Coal Creek site apply similarly to the Slate River Site.

Energy Requirements

Energy consumption and conservation potentials are discussed on pages 107 and 201. Other than related to ore haulage, no outstanding differences in energy consumption were identified.

Water

During construction, a small risk will exist that sediment-laden runoff could enter the Slate River during runoff events. However, because of the generally flat slopes in the site area this risk will be substantially less than for the Coal Creek site. A low probability worst-case event will produce temporarily high sediment concentrations which will be flushed downstream without causing noteworthy damage.

Placement of fill on Slate River wetlands will probably require a Section 404 Dredge and Fill Permit from the Army Corps of Engineers.

During operation, the risk of sediment and various spills entering the Slate River will

TABLE 4-16 MAXIMUM CONCENTRATIONS OF MINE EXHAUST EMISSIONS IN THE COAL CREEK VALLEY

Pollutant	Maximum Predicted Concentration (ug/m3)	Direction to Maximum Concentration	Distance from Site Center to Maximum Concentration (km)	State/ Federal Standard (ug/m3)
TSP				
Annual	11.3	ENE	3.0	60
24-hour	31.9	ENE	3.0	150
SO_2				
Annual	9.4	ENE	1.5	80
24-hour	38.9	ENE	2.0	365
3-hour	198.2	NE	1.0	1,300
NO_x				
Annual	46.8	ENE	2.0	100
CO				
8-hour	28.8	ENE	1.5	10,000
1-hour	197.6	NE	1.0	40,000

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Source: AMAX (1981a)

be low. Following reclamation, increased infiltration rates should keep runoff and potential erosion at a minimum.

Air

Fugitive dust will be emitted during construction and will be minimized using the controls listed in Appendix B. A year-by-year schedule of emissions cannot be predicted for this site because it has not been designed and planned as fully as the Coal Creek site. However, it is reasonable to expect that fugitive emissions from construction and operation will approximate those shown in Figure 4-4 (page 133).

Point source emission sources and quantities should be similar to those of the Coal Creek site (Tables 4-9 and 4-10 on page 134 and Figure 4-4 on page 133).

As described in Chapter 2, the ventilation facilities could approach the underground workings from either the Coal Creek drainage or the Slate River site. The difference is noteworthy in terms of air quality because the mine is predicted to exhaust 87 tons per year of carbon monoxide. For a Coal Creek entrance, the resultant concentrations from mine exhaust are listed in

Table 4-16, while the concentrations from the mine site are shown in Table 4-17. Concentrations for a Slate River exhaust were not modeled. Although they would likely be higher than those shown in Table 4-17, they would probably fall well within permissible standards. However, even though the points of maximum concentration are generally to the east of the mine site, some emissions may move south and mix with those generated in the Town of Crested Butte. As some air quality problems may exist in the Town at that time (see page 205), the situation could become slightly worse.

Emissions and resultant concentrations of Colorado-designated hazardous pollutants are expected to be similar to those listed in Table 4-12 on page 135.

Noise

Noise levels during construction and operation will be similar to those of the Coal Creek mine site. How-

TABLE 4-17 MAXIMUM CONCENTRATIONS OF POINT SOURCE EMISSIONS: SLATE RIVER MINE SITE*

Pollutant	Maximum Predicted Concentration (ug/m3)	Direction to Maximum Concentration	Distance from Site Center to Maximum Concentration (km)	State/ Federal Standard (ug/m3)
TSP				
Annual	13.6	E	0.5	60
24-hour	17.6	E	1.0	150
SO_2				
Annual	4.2	E	1.0	80
24-hour	22.9	E	1.25	365
3-hour	51.8	WSW	0.5	1,300
NO_x				
Annual	18.3	E	1.0	100
CO				
8-hour	14.2	E	1.0	10,000
1-hour	33.2	WSW	0.5	40,000

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*Ventilation exhaust is not included.

Source: AMAX (1981a)

ever, because the Slate River site is closer to the Town of Crested Butte and outlying homes (Map 1), A-weighted noise levels may reach 40-45 dB at the Town (Mirabelli, 1980). These levels are similar to current background levels and may lead to an overall increase in ambient noise levels in these residential areas. The Mt. Crested Butte area would not be impacted.

Cultural Resources

Locating a mine site on the Slate River could cause more disturbance to cultural resources than at the Coal Creek mine site. The potential cost to mitigate direct impacts at this site will be less than $500.

Visual Resources

During construction and operation, the site will create major form, line, color and texture contrasts with the surrounding landscape, and inventoried VQO's will not be met. Because it is close to the Town of Crested Butte and visible from heavily-travelled roads in the vicinity, it will introduce a dominant industrial feature in an otherwise rural Slate River valley setting. Obliteration of the existing facilities at the old Peanut Mine, which is at the Slate River site, will offer some improvement.

Following reclamation, color and texture contrasts will largely be reduced. Form and line contrasts will remain, but once the buildings are removed and vegetation is reestablished, these contrasts will be somewhat diminished by the flat character of the adjacent bottom lands along the Slate River. It should be possible to meet inventoried VQO's. The site will then be less obvious than the Coal Creek site.

Outdoor Recreation

Hiking and fishing conflicts will be negligible.

Fire

The fuels surrounding the Slate River mine site consist primarily of grassland with scattered shrubs and aspen. A normal fire run upslope from the mine site will burn through heavily timbered slopes to a ridgetop within a half mile. Heavy timber fuels lie beyond the ridge in Coon Basin. The fire hazards on this site are considered low to high.

The mine's facilities will be the principal values at risk.

Transportation

Transportation impacts are addressed on page 121.

Socioeconomics

General - See the Socioeconomic discussion for worker access to the Slate River site.

AMAX Costs - Site preparation costs at the Slate River site will probably be less than for the Coal Creek site because of gentler terrain. Driving worker access drifts from either site would probably cost about the same: two are proposed from Coal Creek, but only one (twice as long) would probably be driven from Slate River. An internal manway shaft will be constructed in either case. Ventilation drifts will cost more for Slate River if they are driven from the mine site. But if they are driven from a location in the Coal Creek drainage, the costs will be about the same for either site.

Operating costs for Slate River should be slightly higher because of the site's greater distance from work areas.

Geology

Tunnel access into Mt. Emmons could encounter coal seams. If this happens, additional precautions may be needed to protect against caving and methane gas leaks.

Soils

The principal soil series are Bogan-like, 11 acres; Gateview, 107 acres; Irim, 13 acres; Blanca, 28 acres; Shadow, 11 acres; and Disturbed Land, 22 acres. Irim soils have good reclamation potential. Bogan-like soils have fair to good reclamation potential. The reclaimability of Disturbed Land soil depends on the degree of existing disturbance and the remaining quantity of usable topsoil material. Blanca, Shadow and Gateview soils were described under the Coal Creek site.

Land Uses

Timber affected by mine site construction involves unregulated types. Timber yields will be largely unaffected.

The approximate grazing capacity lost due to mine site construction is 75 AUM's. Most of this loss occurs on private land.

Most of the mine site investment would be on private land. This would change about 145 acres of private land from agricultural grazing use to industrial use.

NFS land might still be used for constructing ventilation drifts and installing ventilation equipment. The exact location of this work site is undetermined. The Forest Service could issue special use permits for this activity.

Avalanche Hazard

Avalanche hazards are high for this site (Mears, 1980). Measures will have to be taken to protect structures from damage.

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Worker Access to the Slate River Mine Site

Vegetation

General - Vegetation types disturbed by access road construction are listed in Table 4-14 on page 142. The acres disturbed will be reduced following revegetation, which will begin in the late stages of construction.

Threatened and Endangered Species - No threatened or endangered plant will be affected by constructing the mine access roads.

Wetlands - Reconstruction of Colorado 135 could disturb a maximum of 24 acres of irrigated hay meadow. Construction of a west bypass around the Town of Crested Butte could disturb a maximum of 1 acre of wet sedge meadow, while an east bypass could disturb a maximum of 6 acres of riparian willow and 5 acres of irrigated hay meadow.

Wildlife

The effects on wildlife of constructing the mine access roads are incorporated in the discussion on the Slate River mine site.

Water

Reconstruction of existing roads will have negligible impacts on water quality except for temporary sediment loadings at stream crossings. Most reconstruction will be on relatively flat terrain. New construction around the Town of Crested Butte will also be on generally flat terrain and the risk of sediment loadings will be low.

Air

Minor fugitive emissions will accompany construction.

Noise

Mine traffic noises will be similar to those discussed for the Coal Creek site, except that some residences north of the Town of Crested Butte may be impacted if the eastern bypass is used, and ambient noise levels in Mt. Crested Butte may be slightly raised.

Visual Resources

Reconstruction of Colorado 135 will have the same impacts as discussed for the Coal Creek site. Of the two possible bypass routes around the Town of Crested Butte, the western one would be the more visually striking because it is closer to the Town.

Outdoor Recreation

Hiking and fishing conflicts will be negligible.

Socioeconomics

Some workers will stop in the Town of Crested Butte before driving home, with impacts similar to those described for the Coal Creek mine site.

Land Use

Considerably more conflicts between land uses may have to be resolved to locate the east bypass to the Slate River mine site than to locate the south bypass to the Coal Creek mine site. Possible uses conflicting with the east bypass include hay meadows and proposed subdivisions.

Avalanche Hazard

Both access alternates enter a zone of high hazard as they approach the mine site. The western route passes through more of this zone than does the eastern route.

MILL SITE

PAGE REFERENCE

Alkali Creek 149
    Site Impacts 149
    Ore Haulage 161
    Worker Access . . . 169
Carbon Creek 173
    Site Impacts 173
    Ore Haulage 179
    Worker Access . . . 182
Chance Gulch 185
    Site Impacts 185
    Ore Haulage 191
    Worker Access . . . 197

ALKALI CREEK MILL SITE (Alternatives 2-4)

Alkali Creek Mill Site Impacts

Vegetation

Construction of the Alkali Creek mill site could potentially disturb a total of 1,720 acres, 933 acres of private land and 787 acres of NFS land. Table 4-18 describes potential land disturbance by vegetation type and ownership.

Threatened and Endangered Species - No threatened or endangered plant species will be affected by constructing a mill in Alkali Creek.

Wetlands - Approximately 43 acres of natural wetlands will be covered by the mill site, tailing disposal area, and mill water reservoir. An additional 99 acres of irrigated hay meadow with wetland characteristics will be covered.

Wildlife

Table 4-19 lists the wildlife habitats that will be lost for approximately 30 to 50 years if the Alkali Creek area is used. This table also shows a comparative index value representing the effect on all inventoried wildlife that may use these habitats. This index, described in Appendix I, is used to compare wildlife impacts between alternatives.

Elk and Deer - The lower slopes on the north side of Alkali Basin are used as winter range by both deer and elk. These slopes have been recognized as critical winter range for elk in severe winters (Forest Service, 1976). However, more recent evaluation by the Forest Service did not recognize any critical deer or elk winter range in that area (Forest Service, 1979d). This winter range will be disturbed, but not completely lost, if a mill and tailing disposal area are constructed. This impact could be partially mitigated by making additional winter feed available at other areas of winter concentration.

Although baseline studies provided considerable data about present elk use patterns in the Project area, there is disagreement regarding the most likely effects on elk populations of locating the mill and tailing pond in Alkali Basin. Biologists can cite cases where development activities have apparently drastically reduced resident elk populations. Other biologists cite cases where elk continue their normal life activities in relatively close proximity to developments. Because of

TABLE 4-18. ACRES OF POTENTIAL VEGETATION DISTURBANCE: ALKALI CREEK MILL SITE

	Mill Pad		Tailings & Water Dams		Access Road		Pipelines & Other Facilities		Topsoil Stockpile		Totals	
VEGETATION TYPE	NF*	PVT*	NF	PVT	NF	PVT	NF	PVT	NF	PVT	NF	PVT
Mountain Grassland				18								18
Sparsely vegetated			4								4	
Big sagebrush	72		349	621	166	15	108	27	13	75	708	738
Hay meadow/pasture				69		29		6				104
Rock outcrop/talus				13								13
Riparian				30			1	17			1	47
Aspen woodland					3		29	9			32	9
Moist meadow	6				2						8	
Cottonwood						4						4
Spruce-fir							34				34	
	78	0	353	751	171	48	172	59	13	75	787	933

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* NF = National Forest System land; PVT = Private land

TABLE 4-19. INDEX OF POTENTIAL WILDLIFE IMPACTS: ALKALI MILL SITE

Habitat Type	Acres Disturbed	Index of Total Wildlife Impact*
Riparian	52	187.72
Aspen	41	86.51
Wet Meadow	112	190.4
Dry Meadow	18	30.06
Spruce-fir	34	60.52
Sagebrush	1,446	2,154.54
Rockland	13	12.09
Sparsely vegetated	4	N.A.
	1,720	2,721.84

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*Larger index numbers mean greater adverse impacts to the inventoried wildlife species expected to use these habitats. See Appendix I, Methodology, for ann explanation of index development.

this irreconcilable debate, a worst-case effect is described below:

A recent EIS (BLM, 1980) estimated the wintering elk population in the Gunnison Basin at 8,500. Under worst-case conditions the present population of elk in the Gunnison Basin would be reduced by the number of animals currently using the Flat Top to Mt. Axtell area (approximately 160 wintering elk). This population change translates into a reduction in the annual elk harvest of approximately 50 animals. This effect could last for the life of the project (30 years), at which time steps could be taken to reintroduce elk to the area if natural migration did not produce a desired herd size.

Baseline studies have shown that, although the Flat Top elk herd is relatively isolated from other area herds, there are animals that cross over and join adjacent herds. Therefore, the Basin-wide reduction of elk numbers would probably occur as a result of migration out of the Flat Top area, which would subsequently cause overgrazing of other winter range areas. This would create a management incentive to reduce elk numbers through increased hunting. The probability of all elk leaving the Project area is small, but because any figure is a subjective estimate, this worst-case analysis is presented.

The ecological effects on the Gunnison Basin's elk herds of losing 160 elk in relation to natural mortality (400-1,700 animals per year) and current hunting harvest levels (2,700-3,300 animals per year) are small. Economically, the loss would represent reductions of 4,730 hunting recreation visitor days and $77,000 in Gunnison County's total gross output. This reduction constitutes less than 0.1 percent of the County's total gross output. Mitigation could be accomplished by enhancing the basin's winter ranges to which the affected animals are expected to migrate. This enhancement could be accomplished through reducing livestock use or through intensive management such as fertilizing or burning.

An Alkali Basin mill and tailing facility will also impact certain other wildlife habitats. Mule deer and elk may venture into the basin anytime during the snow-free period. Mule deer also use summer range on Flat Top. The Alkali Basin facilities will not disrupt elk calving areas, but may partially change current elk movement patterns. A major migration route around the east side of Flat Top crosses lower Alkali Basin at the aspen "fingers" in the general area where the mill water reservoir is planned (Map 1). The aspen "fingers" will not be disturbed by AMAX's development. The elk herd generally crosses this area in small bands (10-40 animals) during May and again in late November-early December. A second migration route crosses the west end of Alkali Basin along the ridge between Red Mountain and Flat Top (proposed mill site area).

The construction of the Alkali Basin mill and tailing facilities is not expected to have a significant effect on big game herds now using that area.

Sage Grouse - Alkali Basin is used by sage grouse as summer habitat and development is expected to shift summer use to similar sage habitats west of the Alkali mill site and south-southwest along the west facing sagebrush slopes of Flat Top. Breeding occurs in April and May on the lower southwest reaches of Flat Top with broods moving into the basin by July.

Threatened and Endangered Species - The construction of a mill and tailings pond in Alkali Basin could remove an undetermined portion of the feeding habitat for bald eagles wintering on the East River.

The combination of increased vehicular traffic and increased carrion along Highway 135 could increase the probability of car-eagle collisions.

Because Alkali Creek flows into the East River within one mile upstream from the Roaring Judy Fish Hatchery, contamination of hatchery water sources would also impact this primary food source for the wintering bald eagles. Contamination is not expected.

These potential effects could be mitigated by the following:

(1) Developing a contingency plan to ensure that Project development and operation do not jeopardize the Roaring Judy Fish Hatchery and its continued supply of dead fish to wintering bald eagles.

(2) AMAX cooperating with the Colorado Division of Wildlife to initiate a bald eagle habitat management plan which includes, but is not limited to, the following: (a) Establishing buffer zones between primary feeding areas and development; (b) Retaining large diameter narrowleaf cottonwoods for perch trees, and providing for long-term management of cottonwoods; (c) Not staging new construction during the winter occupancy period in the area; (d) Increasing habitat for prey species such as jack rabbit, cottontail; and (e) Providing for timely removal of big game carcasses and other carrion from Colorado 135 to avoid a possible car-eagle collision.

(3) AMAX providing for the protection of other feeding habitat in the range of the affected eagles. This could be done by donating or exchanging to a public agency private lands which might be subdivided if not in public ownership.

A mill site at Alkali Creek will not affect any other threatened or endangered species.

Aquatic Ecology

The tailing disposal area will cover approximately 2 miles of Alkali Creek. The Creek is a low flow drainage which does not support a fishery but does support benthic invertebrate densities similar to populations occurring elsewhere in the Project area. The loss of this habitat will create a negative impact.

Energy Consumption

The mill access road will be 7.3 miles long, requiring approximately 249,295 million Btu to construct.

As with construction energy, discussed on page 106, an unknown amount of energy would be consumed in reclamation.

Water

During construction there will be a risk of excessive sediment entering Alkali Creek during major runoff events before the tailing dam and mill water reservoir dam are completed. Once the dams are in place this risk will be quite low. A worst-case event of low probability would introduce heavy sediment loads into Alkali Creek and damage the stability of the channel's lower reaches. These sediment-laden waters will probably reach the East River, where they will be diluted. The sediment will be flushed downstream and distributed along several miles of river channel with only minor short-term impacts. The primary adverse impact of such an event will be a temporary increase in turbidity with its attendant adverse visual effects, which would lessen with distance downstream.

Construction of the tailing disposal area and mill water reservoir will require a Section 404 Dredge and Fill Permit from the Army Corps of Engineers.

During operation, surface runoff from the mill site will be routed to the tailing disposal area and will not escape to external drainages.

Surface runoff generated upslope of the tailing disposal area's flood bypass system will be intercepted and routed downbasin. These waters are not expected to contain excessive sediment.

Stream flows in the lower reaches of Alkali Creek will be reduced on an average annual basis due to impoundment behind the main dam and diversion of some bypass waters into the mill water reservoir. Flood peaks may occasionally increase in Alkali Creek's lower reaches due to the bypass system's delivery efficiency. In many cases this effect will be prevented by diversion of flood waters into the mill water reservoir. Some loss of baseflow will occur, which may damage riparian habitat in the lower reaches.

Estimated maximum consumptive use of water for the entire project is about 3,000 acre-feet per year. Most of this will be consumed at the mill and tailing facility. The bulk of this water will be taken from the East River and will consist of waters obtained through a mixture of junior and senior water rights. AMAX has filed for junior water rights on Alkali Creek and the East River to partially fulfill these needs (Water Division Number 4, Case No. 80CW465). These waters will account for about one percent of the mean annual East River flow, as measured at Almont (Figure 3-3 on page 57), and far less than one percent of the consumptive use in the upper Gunnison Basin. In addition, part of the water that will be consumed is already being consumed locally by agriculture. The site of consumption would be altered, and since some irrigation would be discontinued a minor loss in baseflow contributions would result. This is not expected to affect either minimum flow requirements or riparian habitat.

Construction of diversion and pumphouse facilities will require a Section 404 Dredge and fill permit from the Army Corps of Engineers.

The tailing disposal area has been the source of concern because of possible damage to the Roaring Judy Fish Hatchery. Water contamination has been identified as the major threat, either through groundwater pollution or through failure of the main dam. AMAX's proposed design of the tailing disposal area (Figure C-8 on page 337) and monitoring program (AMAX, 1981a, Chapter 8) will minimize these threats. Groundwater contamination will be controlled by the relatively impervious character of the Mancos Shale, the formation's westerly dip, and the planned method of dam construction, which will result in a stable dam structure. It is possible that a seismic event could rupture the dam, but the project area is not seismically active (Walsh, 1980c) and the likelihood of such an event is low. AMAX's proposed monitoring system (AMAX 1981a, Chapter 8) will sample both surface and groundwater flows in lower Alkali Creek, so that any unexpected leakage will be detected. Should the unlikely worst-case condition of uncontrollable leakage occur, it will be possible to pipe East River water to the fish hatchery from a point upstream of Alkali Creek.

The Mancos Shale is a poor aquifer (Giles, 1980 and CDM, 1980a). To the extent that water will seep into it from the tailing deposit, movement will take place along the bedding planes and travel downdip in a northwesterly direction. It would take a few centuries for seepage water to move as far as the Ohio Creek drainage, and at that point the horizons of movement would be well below the alluvial gravels in the valley (Figure 3-13 on page 92a), which are the main source of domestic water in that area.

Water that does seep out of the tailing deposit is not expected to be of poor quality initially. The major factor that could lead to low quality water is the potential of the tailing to generate acid which, in turn, could leach out heavy metals and transport them away. Leaching tests on tailing samples indicate that the acid generation potential of the material is slightly exceeded by its potential to buffer the acid generated (Rinehart, 1979), but it is possible that over the long term the buffering potential could decrease and permit some outflow of acid. This condition may not arise for many years, if at all. Similar leaching tests on Mancos Shale indicate it has a very high acid buffering capability (Rinehart, 1980), which means that any acid water seeping out of tailing deposit will probably be neutralized while it migrates through the Mancos Shale. Thus, the likelihood of acid water problems from the tailing is low.

Air

During construction, fugitive dust will be the dominant emission, accompanied by negligible gaseous and particulate emissions from vehicles. Predicted annual volumes of fugitive dust are shown in Figure 4-5.

During operation, both point source and fugitive emissions will enter the atmosphere. Emission sources are listed in Table 4-20. Quantities of gaseous emissions are listed in Table 4-21. Fugitive and particulate emissions are shown in Figure 4-5. Permits have been issued by the Colorado Air Pollution Control Division covering these emissions. Table 4-22 lists the expected air quality impacts. Compliance with National Ambient Air Quality Standards (NAAQS) is indicated. The impacts of hydrocarbons and carbon monoxide were not modeled because of their relatively low emission levels. Compliance with NAAQS is expected.

Most of the fugitive emissions will be dispersed to the east.

An issue has been raised regarding the impacts of this fugitive dust on local terrestrial and aquatic ecosystems. During operations, fugitive dust will be derived from ore and tailing, which are mineralogically similar to ordinary granitic rocks (Table 4-23). If all of the mill and tailing areas' fugitive dust, spanning the 30-year life of the Project, were spread over one square mile (and dispersion is likely to be noticeably greater than this), the total accumulated thickness of dust would be less than one-tenth

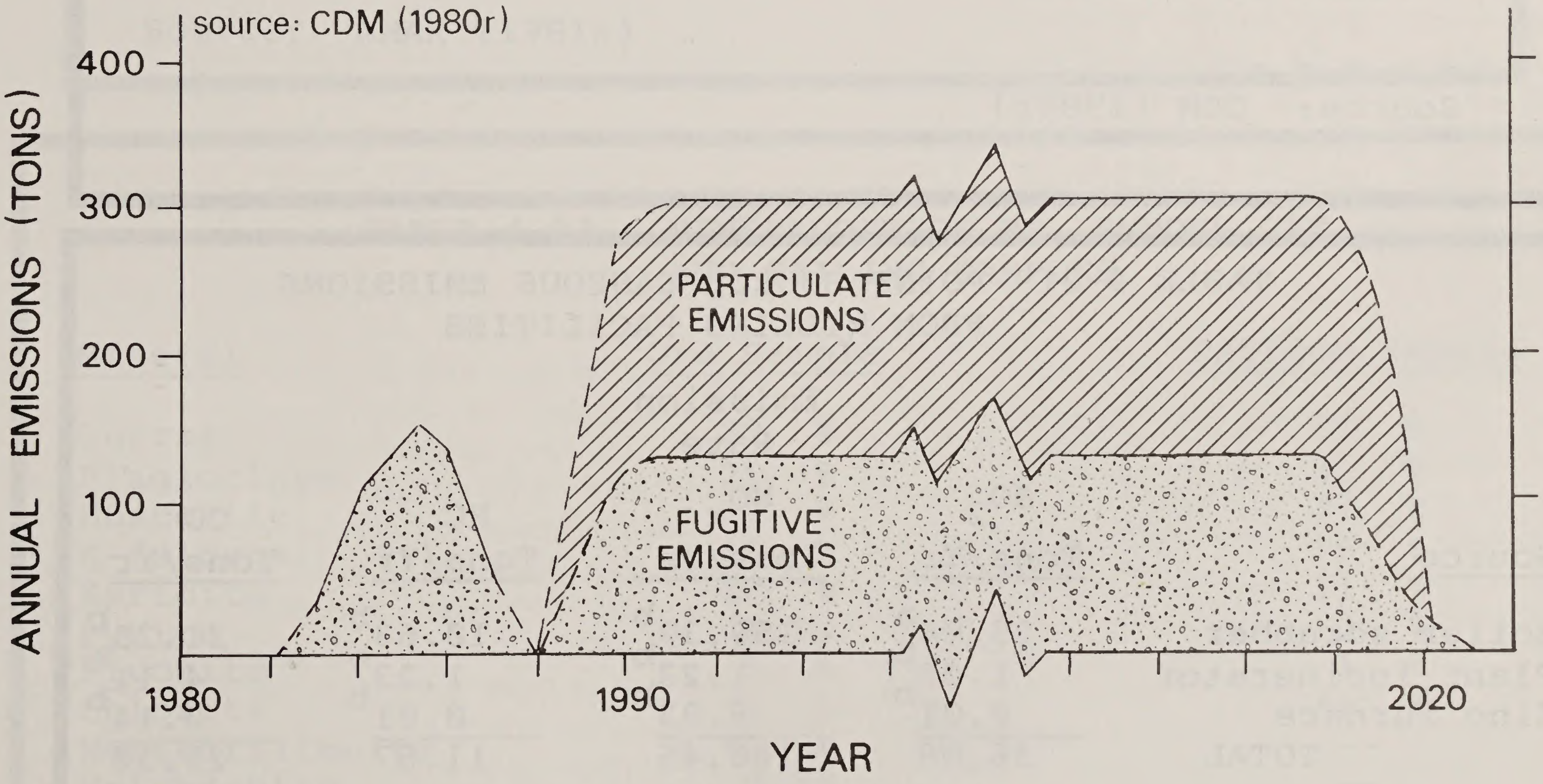

Figure: 4-5 PARTICULATE AND FUGITIVE EMISSIONS FROM THE ALKALI CREEK MILL SITE

TABLE 4-20. MILL-TAILING AREA EMISSION SOURCES

Point Source Particulate Emissions

- Primary Crushing Plant
- Transfer House
- Coarse Ore Reclaim
- Secondary and Tertiary Crushing
- Conveyors No. 8 and 9
- Fine Ore Bin
- Fine Ore Reclaim Conveyor
- Product Loadout
- Product Dryer
- Lead Leach Circuit
- Lime Storage Bin
- Sample Preparation Laboratory
- Boiler

Fugitive Emissions

- Emergency Coal Storage Pile
- Coal Dumping to Hopper
- Waste Rock Stockpile
- Coarse Ore Stockpile (exposed)
- Coarse Ore Stockpile (covered)
- Scraper Operations
- Wind Erosion (Mill & Tailing)
- Haul Roads
- Support Vehicles
- Road Repair
- Watering Trucks

Point Source Gaseous Emissions

- Boiler Scrubber
- Plant Incinerator
- Zinc Furnace

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Source: CDM (1980r)

TABLE 4-21 POINT SOURCE GASEOUS EMISSIONS FROM MILLING FACILITIES

	Emission Rate			
Source	SO_2 Tons/Yr	NO_x Tons/Yr	HC Tons/Yr	CO Tons/Yr
Boiler scrubber	35.04[a]	159.39[b]	10.63[b]	21.25[b]
Plant incinerator	1.03[b]	1.23[b]	1.23[b]	4.11[b]
Zinc furnace	0.01[b]	5.83[b]	0.01[b]	0.14[b]
TOTAL	36.08	166.45	11.87	25.50

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[a] Emission rate based on Stearns-Roger stack test

[b] Emission rate based on EPA-AP42 emission factors

Source: CDM (1980r)

TABLE 4-22 PREDICTED MAXIMUM CONCENTRATION FROM POINT SOURCE EMISSIONS: ALKALI CREEK MILL

Pollutant	Maximum Predicted Concentration (ug/m3)	Direction to Maximum Concentration	Distance from Site Center to Maximum Concentration (km)	State/ Federal Standard (ug/m3)
TSP				
Annual	21.1	SSW	0.5	60
24-hour	32.2	ESE	1.0	150
SO_2				
Annual	2.2	ESE	1.0	80*
24-hour	6.4	ESE	1.0	365*
3-hour	51.2	ESE	1.0	1,300*
NO_x				
Annual	10.3	ESE	1.0	100

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*Federal standard only

Source: AMAX (1981a)

TABLE 4-23. MINERALOGY OF MT. EMMONS ORE AND TAILING SAMPLES

Mineral	Ore Sample	Tailing Sample
Quartz	29 %	27 %
Plagioclase	25 %	25 %
Muscovite	17 %	17 %
K-feldspar	15 %	16 %
Sericite	10 %	11 %
Pyrite	1.5%	2 %
Fluorite	1 %	1 %
Chlorite	<1 %	<1 %
Montmorillonite	<1 %	--
Molybdenite	0.5%	--

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Source: CDM (1980t)

of an inch. Predictions that ecosystem disruption will occur cannot be made.

Predicted concentrations of Colorado-designated hazardous pollutants are expected to be the same as those listed in Table 4-12 on page 135. These indicate that standards will be met.

Noise

Maximum onsite A-weighted noise levels during construction activities will reach 90-95 dB. Heavy equipment such as bulldozers, compressors, etc., will be the main noise sources. Under worst-case conditions, these noises would not drop to background levels for about two miles. This would generally occur with the assistance of atmospheric reflection, which is uncommon. Even at this distance, no residential areas in either the Ohio Creek or East River valleys would be affected.

During operation, A-weighted mill site noise levels will average about 75 dB (Mirabelli, 1980). The primary crusher will be the dominant noise source. Under normal conditions those noises will drop to background levels within a half mile of the mill site. Under the worst-case conditions described above, the noises may carry for a mile, but no further. Residential areas will not be affected.

Some wildlife species will leave the area because of the noise, but some of these may eventually return as they become accustomed to the Project's presence.

Some recreationists in the vicinity may interpret audible Project noises as an intrusion into an otherwise quiet setting, while others may not.

Cultural Resources

Locating the mill and tailings pond at Alkali Creek will directly disturb cultural resources the least of the three mill areas analyzed. Potentially, 28 percent of the impacts could occur on NFS land while about 72 percent of the cultural resource impacts will occur on private land.

Visual Resources

Due to their scale, the mill site and tailing disposal area will become the dominant features in Alkali Basin. This will convert the landscape from its current natural and wild character to an industrial one. The conversion will begin with clearing and earthmoving, and will continue until reclamation. Inventoried VQO's will not be met.

From major travel routes along the East River and Ohio Creek valleys, little of the facilities will be seen. The mill site will not be visible from these roads because of screening by terrain. The mill water reservoir and portions of the main dam will be visible from a mile-long section of Colorado 135 in the vicinity of Jacks Cabin. The same will be true from portions of the Jacks Cabin Cutoff. In both cases, however, these features will not dominate the surrounding landscape. It is likely that, if the mill buildings are designed to conform to the land forms and are not placed on the horizon, inventoried VQO's will be met.

None of the facility will be visible from the City of Gunnison, although during the colder months a steam plume may be visible when surface winds at the mill site move in a westerly direction, a condition that occurs less than ten percent of the time.

Recreationists on Flat Top and Red Mountain will see the facilities clearly from certain vistas. The same will be true for hikers at certain vistas in the West Elk mountains and in the high country east of the Project area. However, in these cases the viewing angle will be low and the facilities will not stand out as much as when seen from the air.

The reclaimed mill site will provide a slight contrast in form and line with the surrounding natural landscape. The reclaimed tailing disposal area, when viewed from an elevated perspective, will provide a similar but greater contrast because of its size. However, with revegetation it should meet inventoried VQO's.

Outdoor Recreation

The mill site falls along one of the major routes used by four-wheel drivers to enter the Flat Top and Red Mountain areas. This route will be closed unless the Forest Service retains access rights through the property or else creates new access around it. If either of these were done, existing use patterns could be retained.

Alkali Basin does not receive much recreational use because most of its area is privately owned and used for grazing. It is more of a viewing area than anything else. A tailing disposal area could well offer as much interest to the occasional viewer as does the basin in its present state.

Fire

The fuels surrounding the Alkali Creek mill site consist primarily of patchy, low growing sagebrush. The fire hazard on this site is considered low.

In addition to the proposed mill site facilities, the values at risk are sagebrush rangeland and wildlife habitat.

Transportation

See pages 121 and 209.

Socioeconomics

For the sake of making general cost comparisons between mill sites, Alkali Creek would probably cost more overall than would Carbon Creek, and less than Chance Gulch. See the discussions on pages 178 and 190.

Geology

Alkali Basin is mantled with slope-failure deposits. While it is possible that tailing deposition could weaken adjacent slopes through saturation and result in slumping, it is not likely to occur. A lake temporarily existed in the Basin about 15,000 years ago, and field evidence indicates that slumping did not occur around its shores while it was present (Robinson, 1980). The slope-failure deposits in the basin were formed under much wetter climatic conditions than currently exist, and they are now considered stable.

Soils

Soils that would be disturbed by construction at the mill and tailing pond site in Alkali Basin are: Big Blue, 243 acres; Cochetopa, 297 acres; Jerry, 289 acres; a bouldery phase of Jerry, 93 acres; Leaps, 132 acres; Rockland, 40 acres; and Alluvial Land, 25 acres. Enough topsoil for reclamation will be available from these soil types.

Big Blue soils are rated by the Soil Conservation Service as having potential agricultural use and therefore are important. In the tailing area this soil is presently used for irrigated pasture. The soil will provide 18 inches of topsoil and has a fair reclamation potential.

Cochetopa soils are clayey, moderately deep, and have a fair reclamation potential.

The bouldery phase of Jerry is found on 30 to 60 percent slopes. These soils are deep, contain about 35 percent coarse fragments, and could provide rip-rap for soils susceptible to erosion. The soils on steeper slopes have a poor reclamation potential.

Leaps soils are somewhat clayey but will provide a fair source of topsoil. Reclamation potential is fair.

Small areas of Alluvial Lands are located in the area. These soils are deep, wet, and difficult to reclaim, as are Rockland soils.

Compared with the other two mill-tailing sites, Alkali Creek stands a better chance of successful reclamation than Chance Gulch, but less chance than Carbon Creek. Chance Gulch receives less moisture than Alkali Basin, while Carbon Creek receives more.

AMAX's reclamation plan specifies a 3 1/2-inch topsoil depth on the tailing disposal area. (See Appendix A.) This may prove too thin for a suitable growing medium. Placement of more topsoil would improve the chances of successful revegetation.

Land Uses

General - No commercial timber land will be affected by constructing the Alkali Creek mill site.

Actual grazing capacity lost from the Cothic Cattle Allotment due to construction of the mill site and associated facilities is estimated at 93 AUM's.

Approximately 100 acres of private hay meadow will be buried by tailing deposition. An additional 820 acres of private rangeland could potentially be lost to construction activities. Upon completion of operations, reclamation should return most rangeland to productivity.

Existing Special Uses - There are no special uses authorized to permittees other than AMAX in Alkali Creek.

Future Special Uses - It is anticipated that if the Alkali mill site is used and a land exchange is not completed, that AMAX would operate the proposed facilities under the authority of the Forest Service's surface mining regulations. This action would require considerable administrative cost by the Forest Service, particularly during construction.

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Ore Haulage to the Alkali Creek Mill

Vegetation

Constructing an ore haulage railroad to the Alkali Creek mill site could potentially disturb either 330 acres or 540 acres, depending on whether the Carbon Creek route (Alternatives 2-3) or the East River route (Alternative 4) is used. Table 4-24 describes potential land disturbance by vegetation type and ownership.

Threatened and Endangered Species - No threatened or endangered plants would be affected by constructing an ore haulage system in either the east or west corridor.

Wetlands - Approximately 11 acres of wetlands will be affected by the Carbon Creek route (Alternatives 2-3). These will mostly be riparian willow thickets at the Coal Creek crossing and the south portal of the Mt. Axtell tunnel. A maximum of 2 acres of riparian willow thicket and 2 acres of irrigated hay meadow could be disturbed by the East River route (Alternative 4).

Wildlife

Table 4-25 lists the wildlife habitats that would be lost for approximately 30 to 50 years if an ore haulage system is constructed to Alkali Creek. This table also shows a comparative index value representing the effect on all inventoried wildlife that may use these habitats. This index, discussed in Appendix I, is used to compare

TABLE 4-24. ACRES OF POTENTIAL VEGETATION DISTURBANCE: ORE HAULAGE TO THE ALKALI CREEK MILL*

VEGETATION TYPE	Carbon Creek Route (Alts 2, 3)	East River Route (Alt 4)
Mountain Grassland	4	50
Subalpine Meadow	15	
Alpine Meadow	6	
Sagebrush	101	226
Aspen	153	201
Spruce-fir	42	30
Hay Meadow		14
Riparian Willow	11	14
Moist meadow		3
Sparse Vegetation		3
Disturbed Area		4
TOTAL AREA	332	545
NFS LAND	276	211

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*Includes access roads and portal areas

TABLE 4-25 INDEX OF POTENTIAL WILDLIFE IMPACTS: ORE HAULAGE TO THE ALKALI CREEK MILL

Habitat Type	Acres Disturbed	Index of Total Wildlife Impact*
CARBON CREEK ROUTE (Alternatives 2, 3)		
Riparian	11	39.71
Aspen	153	322.83
Spruce-fir	42	74.76
Dry Meadow	19	31.73
Sagebrush	101	150.49
Alpine	6	9.06
	332	628.58
EAST RIVER ROUTE (Alternative 4)		
Riparian	14	50.54
Aspen	201	424.11
Spruce-fir	30	53.4
Wet Meadow	17	28.9
Dry Meadow	50	83.5
Sagebrush	226	336.74
Sparsely vegetated	3	NA
Disturbed area	4	NA
	545	977.19

*Larger index numbers mean greater adverse impacts to the inventoried wildlife species expected to use these habitats.
NA = Not Applicable
Appendix I discusses index development.

these wildlife impacts between alternatives. Of the two alternative corridors described in this table, the Carbon Creek route (Alternatives 2-3) has less overall wildlife impact.

Elk and Deer - Both ore haulage corridors affect only big game summer range. In addition, both corridors pass through areas where elk are known to calve. If construction work was in progress in the calving areas between May 15 and June 20, the elk will be displaced from their normal calving areas. This displacement could result in increased calf mortality and, thus, lower elk populations in the Project area (see page 149). This impact can be mitigated by prohibiting construction activity within one mile of the calving areas during the critical time.

During normal operation of the haulage railroad, elk and deer can adapt to regular transport operations. Limited displacement is thus expected. The railroad should not seriously hinder elk and deer movement.

Sage Grouse - Between 150 and 340 acres of sage grouse summer habitat could potentially be disturbed by the Carbon Creek and East River routes, respectively. No strutting grounds will be affected.

Threatened and Endangered Species - No threatened or endangered species are known to inhabit or use either ore haulage corridor.

Aquatic Ecology

The origins for aquatic impacts are analyzed under Water, which begins on this page. The area of Coal Creek that would be impacted is one of the least productive fisheries sampled in the study area. Yet, in terms of benthic macroinvertebrate populations, Coal Creek is one of the most diverse streams sampled (CDM, 1980w, x and y).

Although baseline data at the Carbon Creek impact site were not collected, data from about 4.5 miles downstream describe a stream of intermediate fisheries productivity and benthic diversity.

About 4,000 feet of Coal Creek will be run through a culvert under mine development waste (Alternatives 2, 3). An additional 700 feet of Carbon Creek will be put through culverts under Alternatives 2 and 3.

Energy Requirements

The annual energy consumption of hauling ore to the Alkali Mill via the Carbon Creek corridor (Alternatives 2, 3) is approximately 38,452 million Btu (AMAX, 1981b). This would equate to 107,708 million Btu at the power plant (assuming .327 overall efficiency). These figures are equivalent to the energy required to heat 103 and 289 houses, respectively, in Gunnison County. Ore haulage via the East River corridor (Alternative 4) will require approximately 3.4 times as much energy per year, or 369,997 million Btu. This energy increase is caused by the railroad having to start from a lower elevation. Other energy requirements are identified in Table 4-26.

Water

Groundwater - The Mt. Axtell tunnel (Alternatives 2, 3) is not expected to drain Green Lake. The tunnel will be over 1,000 feet below the lake and no direct hydraulic connections between the two have been identified (DeLong and Stewart, 1979).

Surface Water - Both haulage routes cross Mancos shale terrain which is generally mantled with mass movement deposits. Cut slopes in these materials will tend to slump on a small scale, and the railroad's drainage system may route the material into nearby streams. This can be minimized by keeping the drainage system's waters separate from natural drainages.

The Carbon Creek route (Alternatives 2, 3) will cross Coal Creek, Carbon Creek, and approximately 13 first and second order streams. The Coal Creek crossing will cover about 39 acres. Approximately 4,000 feet of channel will be routed underneath about

TABLE 4-26 ENERGY REQUIREMENTS ORE HAULAGE TO THE ALKALI CREEK MILL

Haulage Route		Annual Million Btu
Carbon Creek Route		
Ore Haulage	13 miles	107,709
Tunnel Construction	6.3 miles	26,939**
Railroad Construction	13 miles	11,668**
		146,317
		(392)*
East River Corridor		
Ore Haulage	20 miles	369,997
Tunnel Construction	2.5 miles	10,691**
Railroad Construction	20 miles	17,951**
		398,639
		(1,069)*

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*Approximate number of Gunnison houses that could be heated per year with the energy consumption identified.

**Although these estimates are short term construction requirements they were divided by the project life of 30 years to display comparable values.

400,000 cubic yards of waste rock from the Mt. Emmons haulage tunnel and other underground workings. Coal Creek will be routed underneath the fill using an arch pipe culvert. This structure will require a 404 Dredge and Fill permit from the Army Corps of Engineers.

The Coal Creek crossing is a significant feature along the Carbon Creek route because AMAX's proposed location for it lies immediately upstream of the Town of Crested Butte's water supply intake. While preparing for fill emplacement, it will be challenging to avoid periods of increased suspended sediment levels at the intake. These periods could have an adverse effect on the Town's water supply, in that the existing treatment facility is currently unable, at times, to remove all sediment prior to distribution. The result is occasional turbidity standard violations. Other sources of sediment, such as airborne dust, may also add to the problem, but to the degree that suspended sediment in Coal Creek is an important contributor, emplacement of the Coal Creek fill could aggravate the problem. Seepage through and around the fill may also contribute sediment. Possible ways of mitigating this risk include: hauling the fill to the mine site, moving the fill below the intake, moving the intake above the fill, improving the Town's water treatment system, or relocating the intake to another watershed. An expanded discussion of some of these can be found on page 252.

The Reclamation Plan in Appendix A calls for removal of the fill once the Project is terminated. This will trigger another period of intermittent suspended sediment increases.

The Carbon Creek crossing will involve placing about 700 feet of channel underneath fill material taken out of the Mt. Axtell tunnel. This structure will require a Section 404 Dredge and Fill Permit from the Army Corps of Engineers. Sediment introduced into Carbon Creek during emplacement of the fill is not expected to have a significant impact on either downstream fisheries or channel stability.

The Carbon Creek road will have to be reconstructed so that heavy equipment can be hauled to the south portal of the Mt. Axtell tunnel. Impacts on water quality will be minor. This work will involve reconstruction of the bridge over Carbon Creek, which will require a Section 404 Dredge and Fill Permit from the Army Corps of Engineers.

The East River route (Alternative 4) will cross Coal Creek (once) or the Slate River (twice), depending on which variation is used. These crossings will probably require a section 404 dredge and Fill Permit from the Army Corps of Engineers. In addition, about 17 first and second order streams will be crossed. The Coal Creek crossing will probably involve a fill similar to that described for the Carbon Creek route. Its impacts will also be similar except that it will be below the Town of Crested Butte's water intake and, thus, will not risk degradation of the Town's water supply.

In the reclaimed state, water quality will approximate baseline conditions.

Air

Fugitive dust will be generated during construction, but because the haulage system is a thin, linear feature, emissions will be minor.

During operation, impacts on air quality will be negligible because the haulage system is to be electrified and the rail bed composed of coarse ballast that does not generate fugitive dust.

Noise

During construction, noise levels near heavy equipment will reach 90-95 dB. Under worst-case conditions this noise may carry as far as two miles before dropping to baseline levels. Momentarily higher levels will occur during blasting at the portals of the Red Mountain, Mt. Axtell, and Mt. Emmons ore haulage tunnels.

During operation, impacts along either alternative ore haulage corridor will be similar. A train will pass any given point approximately once every half hour. Thus the noise will be intermittent. During passage, the A-weighted noise level will be about 75 dB at 100 feet (Mirabelli, 1980). In flat, open terrain this noise would ordinarily drop to background levels in about 2,000 feet, but because the haulage routes pass through uneven topography that is irregularly forested and screens out noise, the zone of impact will be less than 2,000 feet.

Cultural Resources

Constructing the ore haulage system along the East River corridor (Alternative 4) to Alkali Creek will directly disturb cultural resources the least of any haulage system analyzed in this draft EIS. The estimated cost to mitigate these impacts will be insignificant.

In contrast, the Carbon Creek corridor (Alternatives 2, 3) could potentially disturb considerably more cultural resources. The cost to mitigate these impacts could approach 475 times the mitigation cost associated with the East River corridor.

Visual Resources

Surface portions of the ore haulage system will contrast in terms of form, line, and color with the surrounding terrain. However, both routes pass through high-variety terrain with a variety of conifers, aspen, and small open parks that will provide considerable screening from regularly travelled routes. Revegetation of cut and fill slopes will moderate the color contrast. The more visible portions of the routes include: the Coal Creek fill, near the south portal on the Carbon Creek route, the northern half of the East River route, and the final four miles of the East River route as it crosses the unforested terrain on the north side of Alkali Basin. Of these, the northern half of the East River route would be the most visible because of its closeness to and lack of screening from Colorado 135.

Placement of waste rock as fill in the valley bottom will create a dominant visual impact over the short term. But if the surface of the fill is landscaped and revegetated successfully, it should be possible to meet inventoried VQO's by the early 1990's. If the waste rock is hauled to the mine site, the only visual impact at the crossing will be the crossing itself. A trestle or bridge will have less visual impact than even a small fill because upvalley and downvalley views from the Kebler Pass road will not be blocked off as much.

A portion of the waste rock taken from the Mt. Axtell tunnel will be used as fill at the south portal of the tunnel, and over the short term this will create a visual impact. But if the surface of the fill is landscaped and revegetated successfully, it should be possible to meet inventoried VQO's by the early 1990's. The remaining portion of waste from the tunnel will be distributed along the haulage route and will not noticeably increase the route's visual contrasts.

Along the East River route, regardless of mine site, the rail system would have to pass near the Town of Crested Butte. Of the various alternative routes through this area, only the CF&I bench south of town offers any screening. The other route locations are plainly visible from Highway 135. Over 60 percent of the remainder of the route passes through treeless terrain, much of which can be seen from Colorado 135. Given this absence of screening, and the linear feature created by the overhead electricity lines, it will be difficult to meet inventoried VQO's in all places.

Outdoor Recreation

The western haulage route (Alternatives 2, 3) will pass through an area that receives a small amount of four-wheel drive use. Depending on how the rail system is built and managed, existing access through the area could be either improved or reduced. It would be improved if AMAX were to allow public use of the access road next to the railroad. As the Forest Service already has enforcement problems in that area, this would likely make the situation worse. Conflicts between recreationists and the smooth operation of the haulage system can also be expected. Access through the area can be reduced if AMAX does not permit public use of the access road and if it installs the railroad without creating bypasses or crossings for the jeep roads that it intersects. While this may alleviate enforcement problems, it would also preclude access by private landowners and grazing permittees who need to get across the right-of-way. Retention of some access across the right-of-way would help avoid some of these problems.

Opportunities and problems of a similar nature will result if the eastern haulage alternative is used.

Installation of the south portal could preclude development of the potential ski area on Carbon Peak if it resulted in too little flat area being left for a base facility.

If fill from the Mt. Emmons ore haulage tunnel is placed along the Coal Creek valley bottom, as much as 4,000 feet of stream would become unavailable for fishing. As this reach is not fished very heavily, the loss would be minor. The presence of the fill would make it easier for hikers to cross the valley bottom and go into the Green Lake - Mt. Axtell area. It could also be used as a roadside stop.

If the fill is hauled away, the channel would remain open for fishing.

Fire

The primary fuels along either ore haulage route are sagebrush and aspen with small interspersed meadow areas. The value at risk along these corridors is forest land.

Much of the probability of fire starts is mitigated by using an electric rail system.

Transportation

Any railroad crossing of Coal Creek (Alternatives 2-4) would probably require relocating the Kebler Pass road. Associated short term impacts of ground disturbance and traffic interruptions would occur. The haulage system constructed with Alternatives 2-4 would have an access road paralleling the railroad. These roads would provide access to country previously inaccessible and as a result would attract recreational vehicles. If recreationists drive these roads they will have a tendency to create new branching roads where terrain permits. These impacts can be avoided by restricting use of these roads.

Socioeconomics

General - Socioeconomic impacts are not considered sensitive to haulage alternatives.

AMAX Costs - Based on the cost relationships in STRAAM (1978), the capital costs of haulage route construction can be estimated. These are listed in Table 4-27.

If the waste rock extracted from the Mt. Emmons haulage tunnel is not placed along the bottom of Coal Creek and is hauled to one of the mine sites instead, the cost of haulage would be $2.8 million to the Coal Creek site, versus $2.7 million to the Slate River site.

The above figures are in 1980 dollars and should fall within 25 percent of the actual cost (STRAAM, 1978).

Operating costs will likely be higher for the East River route because of the greater elevation climb involved.

Geology

Both alternative ore haulage routes will cross over slope-failure deposits and it is possible that minor slumping will occur.

The East River route (Alternative 4), where it traverses the northern side of Alkali Basin, will cross several major slump blocks. They formed during much wetter climatic conditions than now exist, and they are now considered to be stable (Robinson, 1980). Under unlikely worst-case conditions, however, one or more of these blocks could shift downslope. If this were to happen, the railroad bed

TABLE 4-27 CAPITAL COST OF ORE HAULAGE ROUTES TO THE ALKALI CREEK MILL

	Carbon Creek	East River
Railroad	$3.7	$5.0
Tunnels	4.8	1.9
TOTAL	$8.5	$6.9

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(Figures are in millions of 1980 dollars)

would probably be severed and haulage would be interrupted. Repair, if even possible, could take months.

A similar risk does not exist along the western haulage route.

Land Uses

General - No commercial timber land will be affected by either corridor. Most of the timbered land affected supports aspen.

The cattle allotments directly affected by the Carbon Creek corridor (Alternatives 2, 3) are: Coal Creek, Carbon, Castleton and Gothic. Only one cattle allotment, Gothic, will be affected significantly by the East River ore haulage corridor (Alternative 4). Although the effects on grazing capacity will be negligible, effects on cattle movement could be significant. Where livestock is presently controlled by natural barriers or fences and the ore haulage system passes through them, livestock barriers must be placed in the railroad right-of-way. Some permittees may find the corridor convenient to move cattle in. If the corridor is fenced, livestock movement will be seriously impeded.

Existing Special Uses - There are no special uses authorized in either corridor.

In the Carbon Creek Corridor there are several oil and gas leases on which exploration activity has not been initiated. Ore haulage across these leases is not expected to hinder exploration or development.

Future Special Uses - AMAX has applied for an easement to operate an ore haulage railroad in certain sections of the Carbon Creek corridor (Alternatives 2, 3). It is assumed that if the East River corridor to Alkali were selected similar applications would be made.

Avalanche Hazard

Ore haulage to the Alkali Creek mill will not encounter severe avalanche problems. Most of the terrain involved has a low hazard rating.

The main snow problem will be deep accumulations which will need plowing. The Carbon Creek route should encounter deeper snow than the East River route because it is protected from the wind.

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Worker Access to the Alkali Creek Mill

Vegetation

Table 4-18 on page 150 describes the vegetation that could potentially be disturbed by accessing the Alkali mill from Highway 135. The east access road could disturb 171 acres of NFS land and 48 acres of private land for a total of 219 acres. Reconstruction of critical sections of Colorado 135 (a minimum of 4 miles) would disturb some additional land but the affected area will be relatively small.

New construction of the alternative access road from the west could potentially disturb a total of 125 acres, essentially all sagebrush. About 23 acres of this access road would be on NFS land. Because of traffic volumes, however, about 10 miles of the Ohio Creek road would require reconstruction to widen the road surface and add shoulders and safety features. The acreage and vegetation types affected by this reconstruction were not estimated.

Wetlands - Approximately 4 acres of riparian wetland and 29 acres of irrigated hay meadow will be disturbed by the eastern access. The western access may not disturb any riparian wetland or irrigated hay meadow, but it is possible that an acre or two of nontributary wetland could be disturbed, depending on the final location of the road.

Threatened and Endangered Species - No threatened or endangered plants will be affected by construction of either access road to the Alkali Creek mill site.

Wildlife

Because of the acres and vegetation types described in the preceeding section, the west access road is expected to have less overall impact on all wildlife species.

Elk and Deer - See the discussion under Alkali Creek Mill Site Impacts on page 149.

Sage Grouse - Although the 'typical' alignment shown on Map 1 for the west mill access route will pass more than a mile from any known sage grouse strutting grounds, the corridor does include some of these areas . Roads in the west corridor should be located to avoid known sage grouse strutting areas. Reconstruction of the Ohio Creek road should also be sensitive to critical sage grouse areas.

Threatened and Endangered Species - No threatened or endangered wildlife species will be affected by the construction of access roads.

Energy Consumption

Construction - The east mill access road will be 7.3 miles long and require about 249,295 million Btu to construct. The west mill access road will be about 4.2 miles long and require an estimated 143,430 million Btu.

Reconstruction - Reconstruction on Colorado 135 could require 73,768 million Btu while reconstruction of the Ohio Creek road could require 184,420 million Btu.

Operations - Estimates of annual energy consumption for worker transportation under three different scenarios are shown in Table 4-28.

Water

Both access routes will cross a small number of first and second order streams, with impacts similar to those described on page 108. For the eastern access, the bridge over the East River will have to be reconstructed and a Section 404 Dredge and Fill Permit will be required from the Army Corps of Engineers.

Air

Construction will generate minor fugitive dust.

Noise

Construction of the worker access system will have noise impacts similar to those described for the ore haulage system.

TABLE 4-28 WORKER TRANSPORTATION ENERGY CONSUMPTION: ALKALI CREEK MILL

Transportation Mode	Project Phase (4)	Autos or Trips/Week (5)	Million Btu Per Year (6)
Individual vehicles (1)	Construction	4,420-5,890	30,680-40,883
	Operation	2,686-3,588	30,296-40,470
Car Pooling (2)	Construction	2,950	20,476
	Operation	1,794	20,235
Bussing and Car Pooling (3)	Construction	1,030	9,603
	Operation	650	10,044

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(1) Number of persons per vehicle 1.5 - 2
(2) Number of persons per vehicle 3 (average)
(3) 70% reduction due to bussing, remainder car pooling 3 persons/car
(4) Construction year 1986, operation year 2002
(5) Construction phase = 5 days/week X day shift trips
Operation phase = 5 (day shift + swing shift + graveyard shift) + 2 (weekend + graveyard + swing shift)
(6) Construction = 8 months/year, operation 52 weeks/year
Travel distance = 22.1 miles (worst-case).
Vehicle fuel consumption = 127,600 Btu/gallon ÷ 13.0 miles/gallon (average)

Source: BMML (1981b, Table 10.5-6)

During operation, noise will be generated by worker vehicles and trucks hauling supplies. However, this noise will be substantially less than that generated by mine traffic due to the smaller number of workers involved (212 versus 844 at full production). The main areas of impact will be on the major travel ways rather than on the spurs accessing the site itself. These are included in the noise discussion for worker access to the mine sites.

Cultural Resources

The east access route to the Alkali Creek mill site will create the least impact on cultural resources of any access route to any other alternative mill site. The cost to mitigate cultural resource impacts on the west access route could exceed two times the cost on the east route.

Visual Resources

Worker access roads to the mill, tailing disposal area, and ore haulage system will contrast in terms of form, line, and color with the surrounding terrain. Reconstruction of the Carbon Creek road will similarly increase the visual impact beyond that of the existing road. Revegetation of cut and fill slopes will moderate the color contrast. Portions of the eastern access to the mill will be visible from Colorado 135 near Jacks Cabin. The western access will be visible near the Ohio Creek road, but not further upslope due to terrain screening. Inventoried VQO's can be met.

Outdoor Recreation

Neither an eastern or a western access road to the mill will necessarily conflict with existing recreational uses of the Flat Top and Red Mountain areas. The eastern route already has limited access because of private ownership. The western route may or may not interfere with existing 4-wheel drive roads in the area depending on its final location.

Recreation use of the Flat Top and Red Mountain areas could be made easier if the mill access road were available for public use. Recreationists could drive to The vicinity of the mill and then go north or south into timbered country. Time would be saved. As the Forest Service already has law enforcement problems in these areas, a greater number of problems can be expected.

Access could be made more difficult by the western route if the access right-of-way were closed to public use and the 4-wheel drive roads it intersects were blocked.

Existing public access would be retained if the mill road were closed to public use, but existing 4-wheel drive roads were permitted to cross the right-of-way.

Access into the Carbon Creek area would be improved because of the worker access road needed for construction of the western haulage route. This would occur only if that route is used.

Fire

There would be no significant fire-related impacts from either access road.

Transportation

The east access route will add additional traffic to Colorado 135 which, even in 1980, experienced traffic volumes that exceed a class C level of service on certain sections. This impact can be mitigated by reconstructing the constraining sections of Colorado 135 and by encourageing car pooling or bussing.

The west access route could remove traffic from Colorado 135 but will require major reconstruction of the Ohio Creek road. This reconstruction will probably cause a major long-term change in the character of the Ohio Creek valley.

Geology

The eastern access route is subject to the same major slope-failure risk as discussed for the East River ore haulage route on page 168.

Land Uses

General - No commercial timber land will be affected by either the east or west access route.

The effects on grazing capacity by either access route will be negligible. The increased traffic on either the Ohio Creek road or Colorado 135 will interfere with livestock trailing in the Spring and Fall.

The reconstruction of Colorado 135 will probably all occur within the right-of-way. The reconstruction of the Ohio Creek road will probably have negative effects on agricultural and residential lands.

Existing Special Uses - No existing special uses will be affected by either access road.

Future Special Uses - If a land exchange for the mill site area is not consummated, the Forest Service may issue special use permits for the access roads.

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CARBON CREEK MILL SITE
(Alternatives 5-6)

Carbon Creek Mill Site Impacts

Vegetation

Construction of the Carbon Creek mill site could potentially disturb a total of 1,851 acres, 162 acres of private land and 1,689 acres of NFS land. Table 4-29 describes potential land disturbance by vegetation type and ownership.

Threatened and Endangered Species - No threatened or endangered plants will be affected by construction of the Carbon Creek mill site.

TABLE 4-29. ACRES OF POTENTIAL VEGETATION DISTURBANCE: CARBON CREEK MILL SITE

	Mill Pad		Tailings & Water Dams		Access Road		Pipelines & Other Facilities		Topsoil Stockpile		Totals	
VEGETATION TYPE	NF	PVT	NF	PVT	NF	PVT	NF	PVT	NF	PVT	NF	PVT
Aspen woodland	2		476	10			94				572	10
Spruce-fir forest	89		272	14	81		70		51		563	14
Lodgepole Pine forest			87	63			34		10		131	63
Riparian			60	29			18				78	29
Rock outcrop/talus			32				7				39	
Subalpine meadow			150	23	1		59				210	23
Mountain Grassland			44	23			33		5		82	23
Wet Sedge meadow					1		3				4	
Disturbed area							4				4	
Subalpine willow							6				6	
	91		1121	162	83		328		66		1689	162
											1851	

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* NF = National Forest land; PVT = Private land

Wetlands - Approximately 84 acres of riparian willow thicket will be covered by the tailing disposal area.

Wildlife

Table 4-30 lists the wildlife habitats that will be lost for 30-50 years if the Carbon Creek mill is constructed. This table shows a comparative index value representing the effect on all inventoried wildlife that may use these habitats. This index, discussed in Appendix I, is used to compare wildlife impacts between alternatives.

Elk and Deer - Elk and deer will be displaced from a significant area of summer range. This is not generally considered a limiting factor in the survival of local elk and deer herds.

Sage Grouse - No sage grouse habitat will be affected by the Carbon Creek mill site.

Threatened and Endangered Species - No threatened or endangered species are known to inhabit or use the Carbon Creek mill site.

Aquatic Ecology

Approximately 2 miles of aquatic habitat would be covered by tailing. This length of moderately good brook trout fishery would be lost as a direct result of tailing impoundment. Carbon Creek also has one of the more diverse benthic macroinvertebrate populations of the area streams sampled (CDM, 1980 w, x and y). The possible secondary effects on downstream fisheries are discussed under Water on the opposite page.

TABLE 4-30. INDEX OF POTENTIAL WILDLIFE IMPACTS: CARBON CREEK MILL SITE

Habitat Type	Acres Disturbed	Index of Total Wildlife Impact*
Riparian	113	407.93
Aspen	582	1,228.02
Lodgepole pine	194	517.98
Spruce-fir	577	1,027.06
Wet meadow	4	6.8
Dry meadow	338	564.46
Rockland/talus	39	36.27
Disturbed area	4	NA
	1,851	3,788.52

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*Larger index numbers mean greater adverse impacts to the inventoried wildlife species expected to use these habitats.
NA = Not Applicable
Appendix I discusses index development.

Energy Requirements

Construction - To reach the Carbon Creek mill site from the east, the Kebler Pass road will be paved from the mine cutoff to the mill, a distance of 11 miles. This construction will require approximately 375,650 million Btu. Access via Ohio Creek will require reconstructing 16 miles of the existing road and constructing 7 miles of new road, all to a double lane, class D highway standard. This will require approximately 923,364 million Btu.

Operation - See the Energy discussion under General Impacts on page 106.

Water

Construction of the tailing disposal area will probably require a Section 404 Dredge and Fill Permit from the Army Corps of Engineers.

Similar to Alkali Creek, excessive siltation will be a risk during construction of the tailing disposal area. At this site, however, the potential for adverse impacts will be somewhat higher because the disposal area is narrower, has steeper sides, and offers less opportunity for controlling runoff. Also, Carbon Creek carries more water than Alkali Creek, which increases the amount of sediment moving downstream. The result of a low-probability worst-case event would be siltation in the lower reaches of Carbon Creek and in Ohio Creek. These two drainages are substantially smaller than the East River and would not flush sediment through nearly as well. Depending on the timing of the event there may be a temporary adverse impact on the stream as a fishery.

During operation, runoff from the mill site will be routed into the tailing disposal area and will not escape to external drainages. The same will be true for toxic spills.

Surface runoff generated above the tailing disposal area's flood bypass system will be routed around the area and returned to the Carbon Creek channel below the lowest dam. Carbon Creek itself may be routed via this system, or it may be passed underneath the tailing deposit through culverts. These waters should not contain excessive silt. The flow volumes of Carbon Creek will present some design challenges and will incur some additional risks not encountered at the Alkali Creek site. If the Creek's waters are diverted around the tailing deposit there will be some risk of breaching, and under low-probability worst-case conditions this could lead to downcutting through the tailing dam followed by heavy sedimentation downstream in Carbon Creek and Ohio Creek. Some fishery habitat will probably be lost temporarily, with a few years being needed for recovery. Minor heavy metals contamination (particularly iron and residual molybdenum) could evolve over the long term. Routing Carbon Creek under the deposit will avoid this risk.

As the tailing disposal system will be designed for no discharge, there will be some loss of flow in the lower reaches of Carbon Creek. This will affect both peak flows and base flows. The latter may have an adverse impact on riparian vegetation and on minimum flow requirements for fisheries habitat.

Consumptive use of water for this site will be slightly less than that for Alkali Creek for two reasons: (1) potential evaporative losses will be less because of more frequent cloud buildup during the Summer; (2) the water level in the tailing deposit will have to be kept low to insure stability of the dam face, which means that less water will be trapped in the deposit. A major portion of the water used will probably have to come from Ohio Creek, and this may have an adverse effect on minimum flow requirements and riparian habitat because it would account for about five percent of the mean annual flow of Ohio Creek as measured below Mill Creek.

The tailing disposal area will likely contribute water to groundwater systems. The talus slopes and debris flows underlying the area will make it difficult to control all seepage, and there may be some bedrock aquifers underneath the surficial deposits that could transmit water away from the area. Because of the complexity of the bedrock in the area, it is difficult to predict whether or not some of this water will reach the surface. As discussed for Alkali Creek, this water may be of good quality initially, but as the years pass a decline in quality could result with possible adverse consequences for the fishery in Carbon Creek. This can be reduced to a degree by a number of seepage control measures, but further detailed studies would be required to identify what should be done.

Air

During construction, fugitive dust will be the dominant emission, accompanied by negligible gaseous and particulate emissions from vehicles. A year-by-year schedule of emissions cannot be predicted because this alternative has not been designed and planned as fully as the Alkali Creek site. However, because the climate at this site is similar to Alkali Creek's, it is expected that fugitive dust from construction and operation will resemble that shown in Figure 4-5 on page 155, as will subsequent impacts.

Operational emission sources and quantities should resemble, Alkali Creek's. These are listed in Tables 4-20 and 4-21 on page 156. Resultant concentrations will be different because of local differences in terrain and meteorology. These are listed in Table 4-31, which indicates that National Ambient Air Quality Standards will be met by all but annual TSP. The impacts of hydrocarbons and carbon monoxide were not modelled because of their relatively low emission levels. In both the West Elk Wilderness and the Town of Crested Butte, TSP concentrations will exceed 1 and 5 micrograms per cubic meter for annual and 24-hour averaging periods, respectively (AMAX, 1981a).

Predicted concentrations of Colorado-designated hazardous pollutants are expected to be similar to those listed in Table 4-12 on page 135. These indicate that standards will be met.

TABLE 4-31. MAXIMUM CONCENTRATIONS FROM POINT SOURCE EMISSIONS: CARBON CREEK MILL

Pollutant	Maximum Predicted Concentration (ug/m3)	Direction to Maximum Concentration	Distance from Site Center to Maximum Concentration (km)	State/ Federal Standard (ug/m3)
TSP				
Annual	67.1	NNW	0.5	60
24-hour	60.6	SSW	1.0	150
SO_2				
Annual	10.8	SSW	1.0	80
24-hour	41.6	SSW	1.0	365
3-hour	66.6	SSW	1.0	1,300
NO_x				
Annual	49.2	SSW	1.0	100

Source: AMAX (1981a)

Noise

Noise levels and impacts will be similar to those at the Alkali Creek site. Under uncommon atmospheric conditions, some noise from the mill may be audible at the Lake Irwin Lodge.

Cultural Resources

Locating the mill and tailing pond at Carbon Creek could disturb about 60 percent more cultural resource values than Alkali mill site. The impacts would be far less than those of using Chance Gulch.

Visual Resources

The mill and tailing facilities will become dominant features in the local landscape. Because of the prominence of Carbon Peak and Mt. Axtell, contrasts in form and line will be less than in Alkali Basin, but the presence of coniferous forest surrounding the tailing area will lead to greater color contrasts. Inventoried VQO's will not be met. The western tailing dam and the mill facility will be visible from a short segment of the Ohio Pass road south of the pass, and possibly also from certain vistas in the northeast part of the West Elk Wilderness.

Following reclamation, some contrast in form and line will persist, but as revegetation progresses it should be possible to meet inventoried VQO's.

Outdoor Recreation

Some fishing opportunities on Carbon Creek will be lost if this site is used. Development of a ski area on Carbon Peak will be precluded during the life of the Project, but it is possible that the surfaces of the tailing disposal area could be used for a base area later.

Fire

The fuels surrounding the Carbon Creek mill site vary from dense coniferous forest to large aspen stands to mountain meadows. The fire hazards on this site are considered moderate to high.

In addition to the mill site facilities, the values at risk include municipal watershed and commercial timber.

Transportation

The physical site for the Carbon Creek mill does not impact an existing transportation system.

Socioeconomics

Construction and operation of a mill at this site will probably cost AMAX less than using either of the other two sites because it is closer to the ore body. However, if lining of the tailing disposal area became necessary for seepage control, then the costs would be increased. If all 1,283 acres are lined with clay to a depth of one foot, it would cost approximately $616,000 per mile in 1980 dollars to haul clay in (based on STRAAM, 1978).

Soils

Soil units which would be disturbed at the mill and tailing pond sites by construction at the Carbon Creek site are: Gas Creek, 120 acres; Gateview, 302 acres; Shadow, 260 acres; Blanca, 26 acres; Bogan-like, 16 acres; Cochetopa, 115 acres; Tongue River, 23 acres; Uinta-Tolvar, 76 acres; and Rockland, 386 acres.

In general, a scarcity of suitable topsoil exists in the area. The Uinta-Tolver and Tongue River soils have fair to poor reclamation potentials. Gas Creek soils have a good reclamation potential. Bogan-like soils have fair to good reclamation potential. Rockland is a poor source of topsoil.

This site has a better chance of successful vegetative reclamation than the other two mill-tailing sites because it receives the most moisture.

Land Uses

Approximately 770 acres of commercial timber land could be lost from production if the Carbon Creek mill site were constructed.

The grazing capacity of the Carbon Cattle Allotment (756 AUM's) will be lost for 30-40 years. This allotment will probably not be a manageable unit while the mine is operating. Some undisturbed areas could be joined with adjacent cattle allotments. Upon completion of operations, reclamation should return most of the rangeland productivity.

Existing Special Uses - The mill site and tailing ponds will terminate the need for two existing special uses: a pasture under permit, and a buried powerline under permit to Gunnison County Electric Association.

Future Special Uses - It is anticipated that if the Carbon Creek mill site is used and a land exchange is not consummated (no offer has been made for this mill site), AMAX would operate the proposed facilities under the authority of the Forest Service's surface mining regulations. This would require considerable administrative costs by the Forest Service, particularly during construction.

Avalanche Hazard

Moderate hazards exist in portions of the tailing disposal area. The mill site is hazard-free.

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Ore Haulage to the Carbon Creek Mill

Vegetation

Constructing an ore haulage conveyor to the Carbon Creek mill site could potentially disturb 73 acres. Table 4-32 describes potential land disturbance by vegetation type and ownership.

Threatened and Endangered Species - No threatened or endangered plants will be affected by this ore haulage system.

Wetlands - Approximately 9 acres of subalpine willow wetlands may be disturbed where the conveyor system crosses Coal Creek.

Wildlife

Table 4-33 lists the wildlife habitats that will be lost for approximately 30 to 50 years if an ore haulage

TABLE 4-32. ACRES OF POTENTIAL VEGETATION DISTURBANCE: ORE HAULAGE TO THE CARBON CREEK MILL

VEGETATION TYPE	Conveyor Route, Portal Areas & Access Roads
Subalpine meadow	9
Subalpine willow	9
Spruce-fir	55
TOTAL NATIONAL FOREST	73

TABLE 4-33. INDEX OF POTENTIAL WILDLIFE IMPACTS: ORE HAULAGE TO THE CARBON CREEK MILL

Habitat Type	Acres Disturbed	Index of Total Wildlife Impact*
Riparian	9	32.49
Dry meadow	9	15.03
Spruce-fir	55	97.9
	73	145.42

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*Larger index numbers mean greater adverse impacts to the inventoried wildlife species expected to use these habitats. Appendix I discusses index development.

system is constructed to the Carbon Creek mill site. The table shows a comparative index value representing the effect on all inventoried wildlife that may use these habitats. This index, discussed in Appendix I, is used to compare wildlife impacts between alternatives. Of all alternative ore haulage corridors, the one to the Carbon Creek mill site will have the least overall impact on wildlife.

Elk and Deer - Elk and deer will be displaced during construction. During operation, the conveyor system will impede the movement of these and other wildlife.

Sage Grouse - No sage grouse habitat will be affected by this conveyor system.

Threatened and Endangered Species - No threatened or endangered species will be affected by the Carbon Creek ore haulage system.

Aquatic Ecology

While no major long-term effects on aquatic ecology are expected from the Carbon Creek ore haulage system, some possible effects are discussed under Water on the opposite page.

Energy Requirements

The annual energy consumption to haul ore to the Carbon Creek mill site using a belt conveyor system via Splains Gulch is approximately 64,261 million Btu of electrical energy (AMAX, 1981b). This would equate to 196,518 million Btu at the power plant (assuming .327 overall efficiency). These figures are equivalent to the energy required to heat 172 and 526 houses respectively in Gunnison County.

A tunnel approximately 1.9 miles long from the ore body to an exit in Coal Creek could require approximately

243,746 million Btu to construct. An estimate of energy necessary to construct the 4 mile conveyor system is 36,884 million Btu.

Water

Construction of the conveyor system in Splains Gulch will run a risk of sediment entering Coal Creek. The drainage has a steep gradient (about 10 percent) and steep, narrow valley sides which limit the opportunities for erosion control. In a low-probability worst-case event, sediment will be delivered to Coal Creek. Some fishery habitat could be temporarily damaged, but carefully designed control measures will keep this risk at a minimum.

The Coal Creek crossing will probably require a Section 404 Dredge and Fill Permit from the Army Corps of Engineers.

During operation the risk of excessive sedimentation will be reduced, but some risk will still be present because of the steepness of Splains Gulch. Since the conveyor will be enclosed, there will be little risk of dust escaping.

Air

Some fugitive dust will be emitted during construction, but because the haulage system is a thin, linear feature the impacts will be minor.

Some point source particulate emissions will be generated at the conveyor transfer house during operations. These will be filtered prior to discharge and emissions will be minor.

Noise

Noise levels near heavy equipment during construction will reach 90-95 dB. Under worst-case conditions this noise may carry for two miles before dropping to baseline levels; the Lake Irwin Lodge may be affected momentarily.

Noise emissions from the conveyor will be continuous during operations, but they will not ordinarily carry as far as the Lake Irwin Lodge.

Cultural Resources

The estimated cost to mitigate cultural resource impacts potentially resulting from the ore haulage system approach 5 times the cost of the East River route to Alkali Creek (Alternative 4). These costs are low because of the short distance involved.

Visual Resources

The conveyor system will create a strong linear feature in Splains Gulch. Much of it will be visible from a short segment of the Kebler Pass road, but if it is painted to blend with the surrounding vegetation it may meet inventoried VQO's.

Outdoor Recreation

The existing road in Splains Gulch may be blocked by the conveyor, but access to the headwaters of the drainage would be available via the mill road if it is open to the public.

The conveyor would probably preclude use of Splains Gulch for downhill skiing.

Fire

The primary fuels along the ore haulage route are spruce-fir forest. The fire hazards along this route are moderate to high. The primary value at risk is municipal watershed.

While fires may be accidentally started during construction, the probability of fires starting during operation is low.

Transportation

The installation of the haulage system may require improving the Splains Gulch road. There may also be requests for restricted public access on this road.

Land Use

Approximately 55 acres of spruce-fir timber could be lost by the construction of the haulage system.

There will be no significant effects on livestock grazing.

Existing Special Uses - No authorized special uses will be affected by this ore haulage system.

Future Special Uses - It is uncertain at this time what form of use authorization or land acquisition AMAX might request for operating this system. If easements or a Plan of Operations are involved, Forest Service administration costs will increase. This will not be true if a land exchange is consummated.

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Worker Access to the Carbon Creek Mill

Vegetation

Table 4-29 on page 174 describes vegetation that could potentially be disturbed by accessing the Carbon Creek mill via Coal Creek. Accessing the mill via Ohio Creek will disturb the most area of any alternative access route to any of the alternative mill sites. The Ohio Creek access route will require major reconstruction of about 16 miles of road and new construction of about 6 miles.

Threatened and Endangered Species - No threatened or endangered plants will be affected by construction of either access road.

Wetlands - Approximately 2 acres of riparian willow thicket and subalpine willow thicket will be disturbed by the Coal Creek route, while 2-5 acres of riparian wetland and 15 acres of irrigated hay meadow will be disturbed by the Ohio Creek route.

Wildlife

Because of the land disturbance described in the preceeding section, the Coal Creek route is expected to have less overall impact on all wildlife than the Ohio Creek route.

Elk and Deer - No impacts beyond the General Impacts described on page 105 have been identified.

Sage Grouse - No significant effects on sage grouse are expected from either worker access route to the Carbon Creek mill site.

Threatened and Endangered Species - No threatened or endangered species will be affected by workers accessing the Carbon Creek mill site, either via Ohio Creek or via Coal Creek.

Energy Requirements

Construction - The Coal Creek route could require 102,450 million Btu to construct. The Ohio Creek route could require 198,070 million Btu to construct.

Reconstruction - Road reconstruction along the Coal Creek route could require 230,525 million Btu. Road reconstruction along the Ohio Creek route could require 291,384 million Btu.

Operations - Estimates of annual energy consumption for worker transportation under three different scenarios is shown in Table 4-34.

Water

Construction of either worker access system will entail some risk of erosion and minor sedimentation in local streams, particularly during high-runoff events. This risk would be greatest on the steeper side slopes in the Carbon Creek and Coal Creek drainages.

Construction of crossings over Coal Creek or Carbon Creek will probably require Section 404 Dredge and Fill Permits from the Army Crops of Engineers.

TABLE 4-34. WORKER TRANSPORTATION ENERGY CONSUMPTION: CARBON CREEK MILL

Transportation Mode	Project Phase (4)	Autos or Trips/Week (5)	Million Btu/Year (6)	
			Via Coal Creek	Via Ohio Creek
Individual vehicles (1)	Construction	4,420 - 5,890	52,753 - 70,297	34,700 - 46,248
	Operation	2,686 - 3,588	52,093 - 69,587	34,250 - 45,781
Car Pooling (2)	Construction	2,950	35,208	23,162
	Operation	1,794	34,794	22,890
Bussing and Car Pooling (3)	Construction	1,030	16,513	10,862
	Operation	650	17,270	11,362

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(1) Number of persons per vehicle 1.5 - 2
(2) Number of persons per vehicle 3 (average)
(3) 70% reduction due to bussing, remainder car pooling 3 persons/car
(4) Construction year 1986, operation year 2002
(5) Construction phase = 5 days/week X day shift trips
Operation phase = 5 (day shift + swing shift + graveyard shift) + 2 (weekend + graveyard + swing shift)
(6) Construction 8 months/year, operation 52 weeks/year
Travel distance = 38 miles worst-case via Coal Creek
" " = 25 miles worst-case via Ohio Creek
Vehicle fuel consumption = 127,600 Btu/gallon ÷ 13.0 miles/gallon (average)

Source: BMML (1981a, Table 10.5-6)

Air

Minor fugitive emissions will be generated during construction.

Noise

Impacts will be similar to those discussed for Alkali Creek.

Cultural Resources

The Ohio Creek route could potentially disturb the most cultural resources of any access route to any other alternative mill site. The cost to mitigate cultural resource impacts along this access route could exceed 14 times the mitigation cost associated with the East River route to Alkali Creek (Alternative 4), the impact route of least cultural resource impact.

While accessing the mill via Coal Creek would potentially disturb more cultural resources than the least impact route (the East River route to Alkali Creek), mitigation costs will only be about 3 times higher.

Visual Resources

Reconstruction and paving of the Kebler Pass road, and construction of an extension to the mill will increase visual contrasts along Coal Creek and introduce new ones in the vicinity of Ohio Pass. Reconstruction and paving of the Ohio Creek and Carbon Creek roads will create stronger contrasts than currently exist. Where this route passes next to the tailing disposal area, its visual impact will be subordinate to the disposal area itself. In both cases it will meet inventoried VQO's.

Outdoor Recreation

Similar to the situation for the Alkali Creek mill site, access into the headwaters of Splains Gulch will either be improved or reduced depending on how available the mill road is for public use.

Fire

Other than the general impacts described on page 121, no significant fire-related impacts will occur from either access road.

Transportation

Either access route would become paved, all-weather access to the Kebler Pass area and would be a major change in the transportation system. This change could have both positive and negative effects. Winter recreationists would have automobile access to new areas and pressures may develop to complete an all-weather road over Kebler Pass to the North Fork Valley. The discussion on page 121 also applies to the alternative worker access routes to the Carbon Creek mill site.

Socioeconomics

General - Some mill employees will tend to stop in the Town of Crested Butte after work if the Coal Creek route is used for reaching the mill, with similar impacts as those described for the mine workers. These impacts will be less likely to occur if the Ohio Creek route is used.

AMAX Costs - Snowplowing costs will be higher for this site than for either of the other two mill sites.

Land Uses

New road construction to the Carbon Creek mill could eliminate up to 81 acres of spruce-fir timber on NFS land. Road reconstruction necessary for the Ohio Creek route will probably disturb more timber producing land than the reconstruction necessary for the Coal Creek access route.

Avalanche Hazard

Both access alternatives pass through local zones of low to moderate hazard.

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CHANCE GULCH MILL SITE
(Alternative 7)

Chance Gulch Mill Site Impacts

Vegetation

Construction of the Chance Gulch mill site could potentially disturb 2,184 acres of sagebrush. Nearly all of this area is public land administered by the BLM. Table 4-35 describes potential land disturbance by vegetation type.

An additional, yet undetermined, area would be disturbed to obtain the clay necessary for lining the tailing pond. The location and size of this area have not been determined, but it could involve several hundred acres. After

TABLE 4-35 ACRES OF POTENTIAL VEGETATION DISTURBANCE: CHANCE GULCH MILL SITE

	Sagebrush	Sparsely Vegetated Area
Mill Pad	216	7
Tailings & Water Dams	1786	
Access Road	8	
Pipelines & Other Facilities	92	
Topsoil Stockpile	75	
Subtotals	2177	7
TOTAL	2184*	

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*Nearly all of this is public land administered by the BLM.

the clay is removed the area would be revegetated in accordance with approved reclamation plans.

Threatened and Endangered Species - No threatened or endangered plants will be affected by construction of the Chance Gulch mill site.

Arabis gunnisoniana is a low tufted perennial forb of the mustard (Cruciferae) family. The BLM has found the plant to be endemic to the Gunnison Basin (BLM, 1980b). Populations of this plant are located in Chance Gulch. Although the plant does not have threatened or endangered status, the BLM recognizes it as a "sensitive species"; that is, "species whose populations are consistently small and widely dispersed or whose ranges are restricted to a few localities, such that any appreciable reduction in numbers, habitat availability, or habitat condition might lead toward extinction." (BLM, 1980b). The BLM is committed to manage for sensitive plant species in order to eliminate the need for the future endangered listing of the species by the Fish and Wildlife Service. This plant is currently under "notice of review" by the Fish and Wildlife Service. It is in Review Status 2, which means that "sufficient information is not presently available to biologically support a proposed rule" (USDI-FWS, 1980). It will not be proposed for threatened or endangered status without more information.

Construction of a mill and tailing pond in Chance Gulch will disturb Arabis gunnisoniana and eliminate a portion of its habitat. It is possible that additional information could lead to removing this species from any category of concern. Although information is mounting to support a non-status conclusion (Forest Service, 1981d), official determinations must be made by the Fish and Wildlife Service and by the BLM.

Wetlands - No wetlands will be covered by the millsite or tailing disposal area.

Wildlife

Table 4-36 lists the habitats that will be lost for 30-50 years if the Chance Gulch mill is constructed. This table shows a comparative index value representing the effect on all inventoried wildlife that may use these habitats. This index, discussed in Appendix I, is used to compare wildlife impacts between alternatives.

Elk and Deer - Chance Gulch is recognized as winter range for both deer and elk. It includes a small area that has been recognized as critical deer winter range (Forest Service, 1976). A more recent evaluation by the BLM did not recognize any critical deer or elk winter range in Chance Gulch (BLM, 1980b). This winter range will be lost if Chance Gulch is used. This impact could be partially mitigated by making additional winter feed available at other areas of winter concentration.

Data collected by trapping and radio monitoring elk that wintered north of U.S. 50 did not identify any animals that would be affected by constructing a mill in Chance Gulch. Locating the mill in Chance Gulch would probably affect deer and elk populations less than would a mill

TABLE 4-36. INDEX OF POTENTIAL WILDLIFE IMPACTS: CHANCE GULCH MILL SITE

Habitat Type	Acres Disturbed	Index of Total Wildlife Impact*
Sagebrush	2,177	3,243.73
Sparsely vegetated	7	NA
	2,184	3,243.73

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*Larger index numbers mean greater adverse impacts to the inventoried wildlife species expected to use these habitats.
NA = Not Applicable
Appendix I discusses index development.

in Alkali Creek, but more than would a mill in Carbon Creek.

Sage Grouse - The BLM has estimated sage grouse populations of 1,440 in Chance Gulch and 24,000 in the Gunnison Basin, respectively (BLM, 1981). Several sage grouse strutting grounds are known to occur within or adjacent to the site. Negative impacts to sage grouse populations will occur if Chance Gulch is used. It is possible, however, that the population and strutting grounds could reestablish in other sagebrush areas of the Gunnison Basin.

Threatened and Endangered Species - No listed threatened or endangered species are known to inhabit or utilize the Chance Gulch area.

Aquatic Ecology

The Chance Gulch site is located on an intermittent drainage that is dry most of the year. One man-made pond that supports aquatic organisms will be destroyed during tailing pond construction. Effects on aquatic ecology at the site will be negligible.

The risk of long-term seepage from the tailing pond into Tomichi Creek is a potential impact that is impossible to quantify, but that should be considered. See the discussion under Water, which begins below.

Energy Requirements

Construction - The mill access road will be 2 miles long and will require approximately 68,300 million Btu to construct.

Operations and Reclamation - See the discussion under General Impacts on page 106.

Water

Similar to the discussion for Alkali Creek, there will be a risk of excessive siltation during construction. However, the risk should be lower because of the shallow, open character of the Chance Gulch watershed, which will make it relatively easy to install runoff retention structures upstream (and settling basins downstream) from the sites of disturbance. Under low-probability worst-case circumstances some sediment may still be carried to Tomichi Creek, but it will be flushed harmlessly downstream.

During operation, this risk of sedimentation will be reduced due to the opportunities provided by the relatively flat terrain to construct flood retention and diversion structures.

Unless diverted, runoff from the mill site during construction will flow into Long Gulch. Sedimentation can be controlled because of the flat terrain.

During operation, runoff from the mill site will be routed into the tailing disposal area. The same will be true for toxic spills.

Water flows through Chance Gulch only occasionally during the year, and installation of the tailing disposal area will not noticeably affect Tomichi Creek flows. In fact, a net increase in water quality may result because of the flood control measures that will be taken.

The consumptive use of water at this site will likely be greater than the 3,000 acre-foot maximum estimated for Alkali Creek. The potential for evaporation is greater because of the warmer and drier climate, and the site will offer more surface area from which evaporation could occur. Most, if not all, of the water consumed will probably come from Tomichi Creek. Depending on the water rights obtained, some late-season flows may be reduced in Tomichi Creek as a result of water diversion.

A number of Public Water Reserves exist on BLM lands in the Chance Gulch area. Associated with these are withdrawals that may have to be revoked before the area can be covered with tailing.

Groundwater will be minimally affected because the disposal area will be lined. Some current groundwater flow patterns might be interrupted. A risk will be involved that the lining might rupture, but the risk is low. The worst-case result of rupture will be seepage into the subsurface, which will deliver the water into Tomichi Creek's alluvial gravels. The seepage waters will likely be of good quality early on, but over time they may turn more acidic and carry heavy metals into the Tomichi Creek system. While dilution may prevent serious problems, it is nonetheless possible that water quality could deteriorate sufficiently to impair fishery habitats downstream and possibly contaminate some domestic wells. Detection and preventive treatment will be difficult.

Air

During construction, fugitive dust will be the dominant emission, accompanied by negligible gaseous and particulate emissions from vehicles. A year-by-year schedule of emissions cannot be predicted because this alternative has not been designed and planned as fully as the Alkali Creek site. Because the climate at Chance Gulch is drier and windier than at Alkali Creek, fugitive emissions during construction and operation will likely be greater than those shown in Figure 4-5 on page 155. Subsequent impacts, however, are expected to be similar.

Operations emission sources and quantities should resemble those of Alkali Creek. These are listed in Tables 4-20 and 4-21 on page 156. Resultant concentrations will be different because of local differences in terrain and meteorology. These are listed in Table 4-37 and indicate that National Ambient Air Quality Standards will be met. The impacts of hydrocarbons and carbon monoxide were not modelled because of their relatively low emission levels. During worst-case conditions, nitrous oxide emissions will contribute 1 microgram per cubic meter to the City of Gunnison's air.

Predicted concentrations of Colorado-designated hazardous pollutants are expected to be similar to those listed in Table 4-12 on page 135. These indicate that standards will be met.

Noise

Impacts will be similar to those described for Alkali Creek, except that some residences located along the Tomichi Creek valley may occasionally be impacted by Project noises, particularly during construction.

Cultural Resources

The potential disturbance of cultural resource values at Chance Gulch could approach 200 times the potential impacts of locating a mill at Alkali Creek (Alternatives

TABLE 4-37. PREDICTED MAXIMUM CONCENTRATIONS FROM POINT SOURCE EMISSIONS: CHANCE GULCH MILL

Pollutant	Maximum Predicted Concentration (ug/m3)	Direction to Maximum Concentration	Distance from Site Center to Maximum Concentration (km)	State/ Federal Standard (ug/m3)
TSP				
Annual	29.4	ESE	0.5	60
24-hour	47.0	WNW	0.5	150
SO_2				
Annual	3.9	WNW	0.5	80
24-hour	29.4	W	0.8	365
3-hour	101.0	W	0.8	1,300
NO_x				
Annual	18.1	WNW	0.5	100

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Source: AMAX (1981a)

2-4), which is the least sensitive site.

The following statements were submitted by the State Historic Preservation Officer:

"Chance Gulch is probably more accurately defined as a large archaeological district. Sites identified here establish prehistoric occupation of the area dating from approximately 500 B.C. The entire area could be useful for constructing a resource exploitation model for the western slope. The area contains extraction and manufacturing sites as well as maintenance camps. Needless to say, this is a highly sensitive area archaeologically and for this reason we suggest that the Alkali Creek tailings site would be the better choice for the project site." (Forest Service, 1981e)

Visual Resources

The mill and tailing disposal area will become dominant features in the surrounding landscape. Inventoried VQO's will not be met. The mill facility will be visible from portions of U.S. 50 east of Gunnison, as will the tailing dam, which at its maximum height will cut off the view of distant mountains to the south. Revegetation of the dam face, however, will moderate contrasts in color and texture, but some form and line contrasts will remain. Portions of the mill facility may be visible from certain locations on the Western State College campus.

Outdoor Recreation

Minor recreation use is made of the Chance Gulch area. Loss of this use will be minor.

Fire

The fuel surrounding the Chance Gulch mill site is sagebrush. The fire hazard on this site is moderate to high. The values at risk include sagebrush rangeland, wildlife habitat and Tomichi Creek water quality.

Socioeconomics

Construction and operation of a mill at this site will probably cost AMAX more than either of the other sites. More miles of rail would have to be built and the costs of haulage would be greater (Table 4-42). Lining the tailing disposal area will incur an additional expense that is not assumed for the other sites. If the entire 1,786 acres are lined with clay to a depth of one foot, it will cost approximately $856,000 per mile to haul clay in (1980 dollars, based on STRAAM, 1978). Mancos shale is abundant north of Gunnison and might be usable. If not, a substantially greater haul distance will be necessary.

Soils

The soil units which will be disturbed at the mill and tailing pond sites by construction in Chance Gulch are: Alluvial Land, 478 acres; Lucky Cheadle, 338 acres; Parlin-Hopkins, 353 acres; Parlin-Mergel, 745 acres; and Rockland, 55 acres. Most soils in the Chance Gulch area have only a fair reclamation potential.

This site has the poorest chances of successful vegetative reclamation, compared to the other two mill-tailing sites, because it receives the least moisture.

Land Uses

No commercial timber will be affected by using the Chance Gulch area.

The BLM has prepared plans to improve the grazing capacity in the lower Cochetopa cattle allotment, of which Chance Gulch is a portion (BLM, 1980b and 1981). Reductions in grazing preference on this allotment from use of the Chance Gulch mill are shown in Table 4-38.

Upon completion of operations, reclamation should return most of the rangeland productivity.

No urban, suburban or agricultural land will be affected by this alternative.

Avalanche Hazard

No hazard exists.

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Ore Haulage to the Chance Gulch Mill

Vegetation

Constructing an ore haulage railroad to the Chance Gulch mill site could potentially disturb 494 acres or 468 acres depending on whether the Ohio Creek or the East River corridor, respectively, is used. Table 4-39 describes potential land disturbance by vegetation type for a typical alignment in each corridor. Actual acres could vary considerably depending on final alignments.

Threatened and Endangered Species - No threatened or endangered plants are known to occur in either ore haulage corridor.

Wetlands - Along the Ohio Creek route, 0-12 acres of riparian wetland and 20-72 acres of irrigated hay meadow will be impacted. Along the East River route, 2-23 acres

TABLE 4-38. GRAZING REDUCTION FROM CONSTRUCTION OF THE CHANCE GULCH MILL

Animal Unit Months Lost	% of Total Allotment Capacity	Duration and Situation
312	17	Short-term without treatment
330	18	Long-term without treatment
755	42	Short-term with treatment
755	42	Long-term with treatment

*"Treatment" refers to range improvement treatment as described in BLM (1980b and 1981).

of riparian wetland and 24-62 acres of irrigated hay meadow will be impacted.

Wildlife

Table 4-40 lists the wildlife habitats that will be lost for 30-50 years if an ore haulage system is constructed to Chance Gulch. This table also shows a comparative index value representing the effect on all inventoried wildlife that may use these habitats. This index, discussed in Appendix I, is used to compare wildlife impacts between alternatives.

Elk and Deer - The southern portions of both ore haulage corridors pass through deer and elk critical winter range. Construction activities are not expected to take place during the times that the animals use this range. During normal operation of the ore haulage railroad big game can adapt to regular transport operations and very limited displacement

TABLE 4-39. ACRES OF POTENTIAL VEGETATION DISTURBANCE: ORE HAULAGE TO THE CHANCE GULCH MILL

VEGETATION TYPE	Via Ohio Creek	Via East River
Moist meadow	2	3
Mountain Grassland		19
Wet Sedge	1	3
Subalpine meadow	23	
Alpine meadow	6	
Sagebrush	221	175
Cottonwood	4	42
Lodgepole pine		4
Aspen	77	22
Spruce-fir	39	22
Hay meadow	96	162
Disturbed area	5	1
Urban area		4
Rock/talus		3
Dry Grassland		1
Riparian willow	20	7
TOTAL	494	468
NFS Land	82	21

TABLE 4-40 INDEX OF POTENTIAL WILDLIFE IMPACTS: ORE HAULAGE TO THE CHANCE GULCH MILL

Habitat Type	Acres Disturbed	Index of Total Wildlife Impact*
OHIO CREEK CORRIDOR		
Riparian	24	86.64
Aspen	77	162.47
Spruce-fir	39	69.42
Wet meadow	99	170.99
Dry meadow	23	38.41
Alpine	6	9.06
Sagebrush	221	329.29
Disturbed area	5	NA
	494	866.28
EAST RIVER CORRIDOR		
Riparian	49	176.89
Lodgepole pine	4	10.68
Aspen	22	46.42
Spruce-fir	22	39.16
Wet meadow	168	285.6
Dry meadow	20	33.4
Sagebrush	175	260.75
Rockland/talus	3	2.79
Urban area	4	NA
Disturbed area	1	NA
	468	855.69

*Larger index numbers mean greater adverse impacts to the inventoried wildlife species expected to use these habitats. Appendix I discusses index development.

NA = Not Applicable

would be expected. The railroad should not seriously hinder big game movements.

Sage Grouse - The Ohio Creek ore haulage corridor includes known sage grouse strutting grounds. These sensitive areas could be disturbed by this particular system.

Threatened and Endangered Species - The bald eagle wintering area near Roaring Judy Fish Hatchery is located in the East River haulage corridor. While a railroad through this area might cause no more disturbance than the existing highway, location and design must be sensitive to the eagle.

Aquatic Ecology

The stream crossing impacts associated with ore haulage to Chance Gulch are discussed under Water below. Impacts on aquatic ecology are unlikely to be significant.

Energy Requirements

The annual energy consumption to haul ore to the Chance Gulch mill using an electric rail system via the East River corridor is estimated at 95,446 million Btu of electrical energy (AMAX, 1981c). This equates to 291,884 million Btu at the power plant (assuming .327 overall efficiency). These figures are equivalent to the energy required to heat 256 and 781 houses, respectively, in Gunnison County.

A diesel-electric system was also evaluated. It is estimated to consume approximately 381,404 million Btu per year. This is equivalent to the energy required to heat 1,023 houses in Gunnison County.

The energy requirements of other alternatives are identified in Table 4-41.

Water

Risks of erosion and sedimentation will be greatest along Carbon Creek and in the area northeast of Gunnison, but even under worst-case conditions the impacts are not likely to be significant.

The Ohio Creek route will cross Coal Creek, Carbon Creek, the Gunnison River, and Tomichi Creek. The East River route will cross Coal Creek (once) or the Slate River (twice), possibly the East River (an indeterminate number of times), the Gunnison River, and Tomichi Creek. Both routes cross at least a score of first and second order streams.

Major stream crossings will probably require a Section 404 Dredge and Fill Permit from the Army Corps of Engineers. Some minor stream crossings may also require these permits, as could the construction of rail beds across wetlands.

The water quality impacts of crossing Coal Creek will be less than under Alternatives 2 and 3 because fill will not be placed along the valley bottom. Minor temporary sediment increases will accompany trestle construction, but the impact will not be significant.

The water quality impacts of crossing Carbon Creek will be the same as under Alternatives 2 and 3.

In the reclaimed state, water quality is expected to approximate current conditions.

Air

Because the haulage system is a thin, linear feature fugitive dust emissions will be minor during construction.

During operation, impacts on air quality will be minor even though some exhausts from the diesel-electric railroad will be emitted.

TABLE 4-41 ENERGY REQUIREMENTS OF ORE HAULAGE TO THE CHANCE GULCH MILL

Alternative Haulage System		Annual Million Btu
Ohio Creek Corridor		
Ore Haulage	32.0 miles	270,733
Tunnel Construction	6.3 miles	26,939**
Railroad Construction	32.0 miles	28,721**
		326,393
		(827)*
East River Corridor		
Ore Haulage	34.5 miles	291,884.55
Tunnel Construction	2.6 - 5.7 miles	11,119 - 24,373**
Railroad Construction	34.5 miles	30,965**
		333,968.55 - 347,222.55
		(875 - 887)*

*Approximate number of Gunnison houses that could be heated per year with the energy consumption identified.

**Although these estimates are short term construction requirements they were divided by the project life of 30 years to display comparable values.

Noise

Noise impacts during construction will be similar to those for Alkali Creek, except that a greater area will be affected due to the route's longer length. Any route to Chance Gulch will in places pass near residential areas.

During operation, noise impacts generated by train traffic will also be similar to the Alkali Creek impacts. Trains will run less often, but the noise will carry further due to the general flatness of the terrain. Residential areas along the route will be affected.

Cultural Resources

Constructing the ore haulage system to Chance Gulch in the Ohio Creek corridor could potentially disturb the most cultural resources of any of the ore haulage systems to any of the alternative mill sites. The costs to mitigate these impacts will be significant.

The costs to mitigate cultural resource impacts associated with an ore haulage system to Chance Gulch via the East River corridor will be less than 10 percent of the above costs.

Visual Resources

The visual impacts of the northern portions of both major haulage alternatives are similar to those discussed for Alkali Creek, except for the Coal Creek crossing, where only a trestle will be visible. Where the routes pass through or adjacent to the Ohio Creek, East River, and Tomichi Creek valley bottoms, some contrasts in form, line, color and texture will be created. These contrasts will be most noticeable to the most people where routes are closest to major roads. Since the heaviest traffic volumes north of Gunnison are on Colorado 135, the East River route will be seen by the greatest number of people. The haulage route northeast of Gunnison will create visual contrasts that are greatest where closest to town. Inventoried VQO's will be difficult to meet in this area.

Outdoor Recreation

The existing road into Long Gulch is currently open to public access. If this is continued, the resultant impact of public recreation will be minor.

Fire

The fuels in either ore haulage corridor vary from moist meadow to sagebrush slopes. The fire hazards in either corridor are considered low to moderate. The values at risk vary from residential areas to agricultural land to big game winter range.

The probability of fire starts is lowered considerably by using an electric rail system.

Transportation

Either alternative ore haulage route will have to cross Colorado 135 at least once and U. S. 50 once. The best way to mitigate possible conflicts and accidents at these crossings will be to design crossings so that the ore haulage system is on a different level than the Highway. An undetermined number of secondary roads and jeep trails will also be crossed.

Socioeconomics

General - Mill workers will tend to live within reasonable driving distance of work. The spatial allocation of Mt. Emmons workers shows 76 more employees living in the Gunnison area compared to the Alkali Creek mill site (BMML, 1981a).

AMAX Costs - Based on the cost relationships in STRAAM (1978), the capital costs of haulage route construction can be estimated. These are shown in Table 4-42.

The East River haulage route could exit from Mt. Emmons either in the Coal Creek drainage or at the Slate River mine site. If the former is used, then a waste rock situation will arise similar to that for the Ohio Creek route's Coal Creek crossing. The costs of moving that waste rock to either mine site will be $2.8 million to the Coal Creek site, versus $2.7 million to the Slate River site.

The above figures are in 1980 dollars and should fall within 25 percent of the actual cost (STRAAM, 1978).

TABLE 4-42 CAPITAL COST OF ORE HAULAGE TO THE CHANCE GULCH MILL

	Ohio Creek	East River
Railroad	$9.0	$10.0
Tunnels	4.4	1.9
TOTAL	$13.4	$11.9

(Figures are in millions of 1980 dollars)

Operating costs should be approximately the same for either route.

Land Uses

The effects on commercial timber lands of an ore haulage system in either ore haulage corridor will be negligible (Table 4-39 on page 192).

It is also unlikely that hauling ore in either corridor will significantly affect the grazing capacity of NFS lands.

The major land use impacts of ore haulage to Chance Gulch would be to the private land owners whose land might be crossed. It is impossible to identify the people or properties that might be impacted. Landowners might realize financial benefit while having significant portions of their land changed to a railroad right-of-way.

Avalanche Hazard

The Ohio Creek route passes through areas of low hazard. The East River route also involves low hazards except near the Slate River mine site and near the base of Gibson Ridge.

Worker Access to the Chance Gulch Mill

Vegetation

Table 4-35 on page 185 describes the vegetation that could potentially be disturbed by accessing the Chance Gulch mill site. Because this access road would be relatively short (approximately 2 miles of construction and reconstruction), the area of disturbance is small.

Threatened and Endangered Species - No threatened or endangered plants will be affected by constructing the access road to the Chance Gulch mill.

Wetlands - Approximately 2 acres of irrigated hay meadow will be disturbed.

Wildlife

The Chance Gulch access road will have an insignificant impact on wildlife.

Elk and Deer - About 8 acres of limited use deer and elk winter range will be lost.

Sage Grouse - There are no known sage grouse strutting grounds affected by the access road. About 8 acres of sagebrush habitat will be lost.

Aquatic Ecology

The access road will cross Tomichi Creek and a new structure will have to be installed at the crossing. The effects on aquatic ecology of this construction will be short-term and unlikely to be perceptible the year after construction.

Energy Requirements

Construction - The mill access road will be about 2 miles long and require approximately 68,300 million Btu to construct.

Operations - Estimates of annual energy consumption for worker transportation under three different scenarios are shown in Table 4-43.

TABLE 4-43 WORKER TRANSPORTATION ENERGY CONSUMPTION: CHANCE GULCH MILL

Transportation Mode	Project Phase (4)	Autos or Trips/Week (5)	Million Btu/Year (6)
Individual vehicles (1)	Construction	4,420 - 5,890	16,791 - 21,043
	Operation	2,686 - 3,588	9,596 - 12,819
Car Pooling (2)	Construction	2,950	10,539
	Operation	1,794	6,409
Bussing and Car Pooling (3)	Construction	1,030	4,943
	Operation	650	3,181

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(1) Number of persons per vehicle 1.5 - 2.
(2) Number of persons per vehicle 3 (average).
(3) 70% reduction due to bussing, remainder car pooling 3 persons/car.
(4) Construction year 1986, operation year 2002.
(5) Construction phase = 5 days/week X day shift trips.
Operation phase = 5 (day shift + swing shift + graveyard shift) + 2 (weekend + graveyard + swing shift).
(6) Construction 8 months/year, operation 52 weeks/year.
Travel distance = 7 miles worst-case.
Vehicle fuel consumption = 127,600 Btu/gallon ÷ 13.0 miles/gallon (average).

Source: BMML (1981B, Table 10.5-6)

Water

Impacts will be minimal because of the short length of road and the general flatness and dryness of the terrain. This is true of both construction and operation. The bridge over Tomichi Creek may have to be reconstructed, and this will probably require a Section 404 Dredge and Fill Permit from the Army Corps of Engineers.

Air

Minor fugitive dust will be generated during construction.

Noise

Noise impacts from traffic to the Chance Gulch mill site will be similar to those of the Alkali Creek site, but the impacts will be on a different geographic area. Ambient noise may increase slightly at Tomichi Heights and other residences east of Gunnison.

Cultural Resources

Because of the short length of this access road, the possible impacts on cultural resources are only slightly greater than on the least impact (east) access to the Alkali Creek mill (Alternatives 2-4).

The cost to mitigate will be small.

Visual Resources

Impacts are the least of all mill site alternatives. The new paved road into Long Gulch will offer slightly increased visual contrasts over the existing gravel road, which will be visible to passers-by from a short segment of U.S. 50 east of Gunnison. Inventoried VQO's will be met.

Outdoor Recreation

Very little of either haulage alternative will cross public lands. The impacts on outdoor recreation will thus be minor. Some access problems could arise northeast of Gunnison. These are similar in nature to those discussed for the Alkali Creek ore haulage system.

Fire

The access road passes through sagebrush fuels. This hazard is considered moderate to high.

The values at risk are big game winter range and soil stabilization.

Transportation

The Chance Gulch mill site could relieve Colorado 135 of up to 6,000 auto trips per week during construction and up to 3,600 auto trips per week during operations. This volume of traffic will be added to U.S. 50 for about 7 miles east of Gunnison.

The above numbers will be less with car pooling or bussing.

Socioeconomics

Mill workers will tend to live within reasonable driving distance of work. The spatial allocation of Mt. Emmons workers shows 76 more employees living in the Gunnison area compared to the Alkali Creek mill site (BMML, 1981a). If working at the latter location, these workers are expected to live in the East River area between Almont and Crested Butte.

Land Uses

No significant effects on land uses are expected as a direct result of this access road.

PRODUCTION RATE

PAGE REFERENCE

Vegetation. 200
Wildlife. 201
Aquatic Ecology 201
Energy. 201
Water 203
Air 203
Noise 208
Cultural Resources. . . . 209
Visual Resources. 209
Outdoor Recreation. . . . 209
Fire. 209
Transportation. 209
Socioeconomics. 209
Geology 219
Soils 219
Land Use. 219
Avalanche Hazard. 219

The four production rates and mine lives analyzed are:

Production Rate (TPD)	Alternative	Mine Life Years
0	1	0
10,000 TPD	6	12
20,000 TPD	2-5	30
30,000 TPD	7	20

The analyses in this Section focus on impacts that are sensitive to production rate differences. Many physical and biological impacts are discussed elsewhere in this draft EIS and are referenced as appropriate.

Onsite impacts are discussed in detail in preceding sections. There is very little difference between onsite impacts of the alternative production rates, the most noteworthy ones are those that will terminate with the Project. Included are: air and noise emissions, and energy consumption. Such impacts will end almost 20 years sooner under 10,000 TPD (Alternative 6) than under the 20,000 TPD (Alternatives 2-5). Recovery from other impacts, such as wildlife displacements and vegetation disturbance, will begin that much sooner.

VEGETATION

Construction of a 10,000 TPD mill at Carbon Creek (Alternative 6) could potentially disturb a total of 865 acres (Table 4-44). Nearly all of this area is NFS land. Vegetation impacts discussed in previous sections relate to both 20,000 and 30,000 TPD production rates.

Threatened and Endangered Species - No threatened or endangered plants will be affected by the different production rates.

Wetlands - Approximately 38 acres of riparian willow thicket and wet sedge meadow will be covered by the tailing disposal area for a 10,000 TPD mill at Carbon Creek.

Wetland impacts discussed in previous sections apply to

TABLE 4-44. ACRES OF POTENTIAL VEGETATION DISTURBANCE: CARBON CREEK MILL SITE (ALTERNATIVE 6)

	Ore Haulage	Mill Pad	Tailings and Water Dams	Access Road	Pipelines and Other Facilities	Topsoil Stockpile	Totals
Subalpine meadow	9		15	1	48		73
Subalpine willow	9				6		15
Wet Sedge meadow				1			1
Mountain grassland			23		37		60
Spruce-fir	57	41	186	81	28	30	423
Aspen		2	115		37		154
Lodgepole pine			51		12	8	71
Rock/talus			16		11		27
Disturbed area					4		4
Willow thicket					37		37
TOTALS	75	43	406	83	220	38	865

both 20,000 and 30,000 TPD production rates.

WILDLIFE

Because of the reduction in disturbed area under Alternative 6, the total wildlife index and habitat loss would be somewhat less than those described for the Carbon Creek mill site (Alternative 5).

Other wildlife discussions for the Carbon Creek Mill Site apply similarly to the 10,000 TPD production rate.

AQUATIC ECOLOGY

The same aquatic risks described for the Carbon Creek mill site apply to the 10,000 TPD production rate. About one-half mile of stream might be buried under the tailing disposal area.

ENERGY

To describe the direct Project-related energy requirement for a 20,000 TPD mine, AMAX submitted the estimates shown in Table 4-45 and summmarized below.

TABLE 4-45. PREDICTED ENERGY CONSUMPTION: ALTERNATIVES 2-5

Fuel Type	Btu/year ($x10^{10}$)	Btu/lb. Molybdenum
Diesel	8.7	3,002
Gasoline	1.2	410
Coal	50.0	17,260
Electrical	258.0	88,970
TOTAL	317.9×10^{10}	109,642
or	131.35×10^{6}	Btu/ton MoS_2

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Source: AMAX (1981a)

Electrical Power Consumption - The Mount Emmons Project will require a maximum of approximately 55 mW of electrical power when producing at the rate of 20,000 TPD (Alternatives 2-5). This represents a threefold increase over the current electrical requirement in the Gunnison County Electric Association (GCEA) service area.

Diesel Fuel Consumption - Approximately 1,717 gallons per day will be consumed by diesel equipment at the 20,000 TPD production rate, based on consumption rates experienced during 1979 at AMAX's Henderson facility.

Gasoline Consumption - Based on 1979 Henderson usage rates, approximately 260 gallons per day of gasoline will be consumed at the Project, primarily to fuel company service vehicles.

Coal Consumption - Based on 1979 Henderson usage rates, an average of approximately 65 tons/day of coal will be consumed in each of the coal-fired boiler systems at the mine and mill to provide steam for space heating and process requirements. This amounts to an average annual consumption of approximately 24,000 tons at each site.

Propane and Natural Gas Consumption - Only minor amounts of propane usage are anticipated for the Project.

Data from Colorado Energy Research Institute conclude that in 1977 Colorado's molybdenum industry consumed 158 million Btu of primary energy per ton of MoS_2 (CERI, 1980). These data would suggest that a 20,000 TPD mine would consume 3.825 trillion Btu per year. This figure is comparable to the consumption estimated by AMAX in Table 4-45.

Although there may be some economies of scale, estimation of the direct Project-related energy requirement for a 30,000 TPD mine used the same energy per ton as the 20,000 TPD mine. This rate was also used for the 10,000 TPD mine.

Indirect Energy Requirements - Both AMAX employees and new people providing support services will consume energy in their daily lives apart from the direct Project-related energy discussed above. Indirect Project-related energy requirements were estimated using baseline consumption data and population projections from BMML (1981a). A prediction of energy consumption in the Gunnison Basin with a 10,000 TPD mine is presented in Figure 4-6.

Predictions of energy consumption in the Gunnison Basin with 20,000 and 30,000 TPD mines are presented in Figures 4-7 and 4-8. It is assumed that the total energy consumption for the life of the mine would be essentially the same for both production rates since the total ore production is the same.

WATER

Water impacts under all production rates will be similar to those described in previous sections.

AIR QUALITY

No Action (Alternative 1)

Air quality impacts resulting from secondary

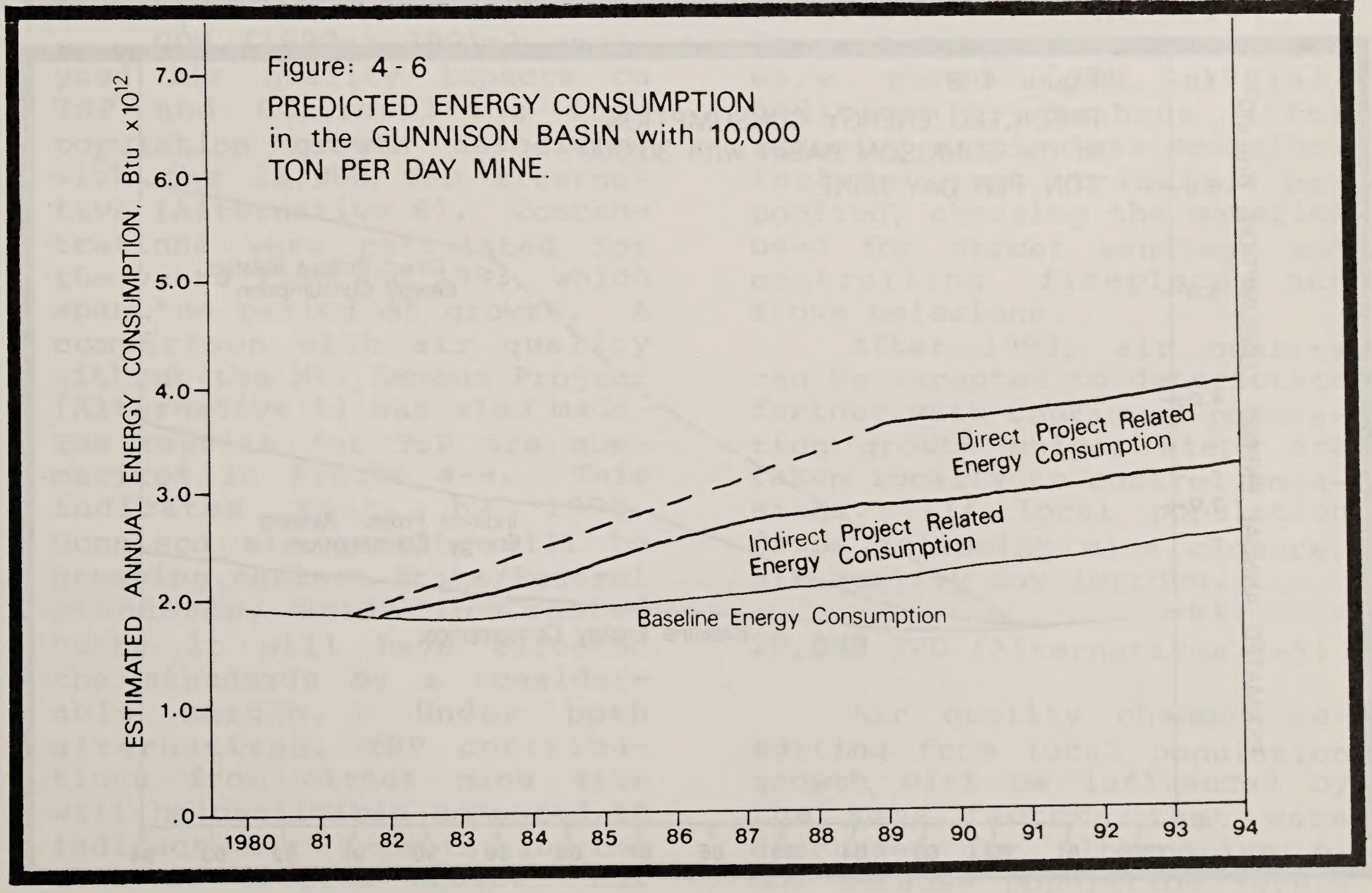


Figure: 4 - 6
PREDICTED ENERGY CONSUMPTION in the GUNNISON BASIN with 10,000 TON PER DAY MINE.

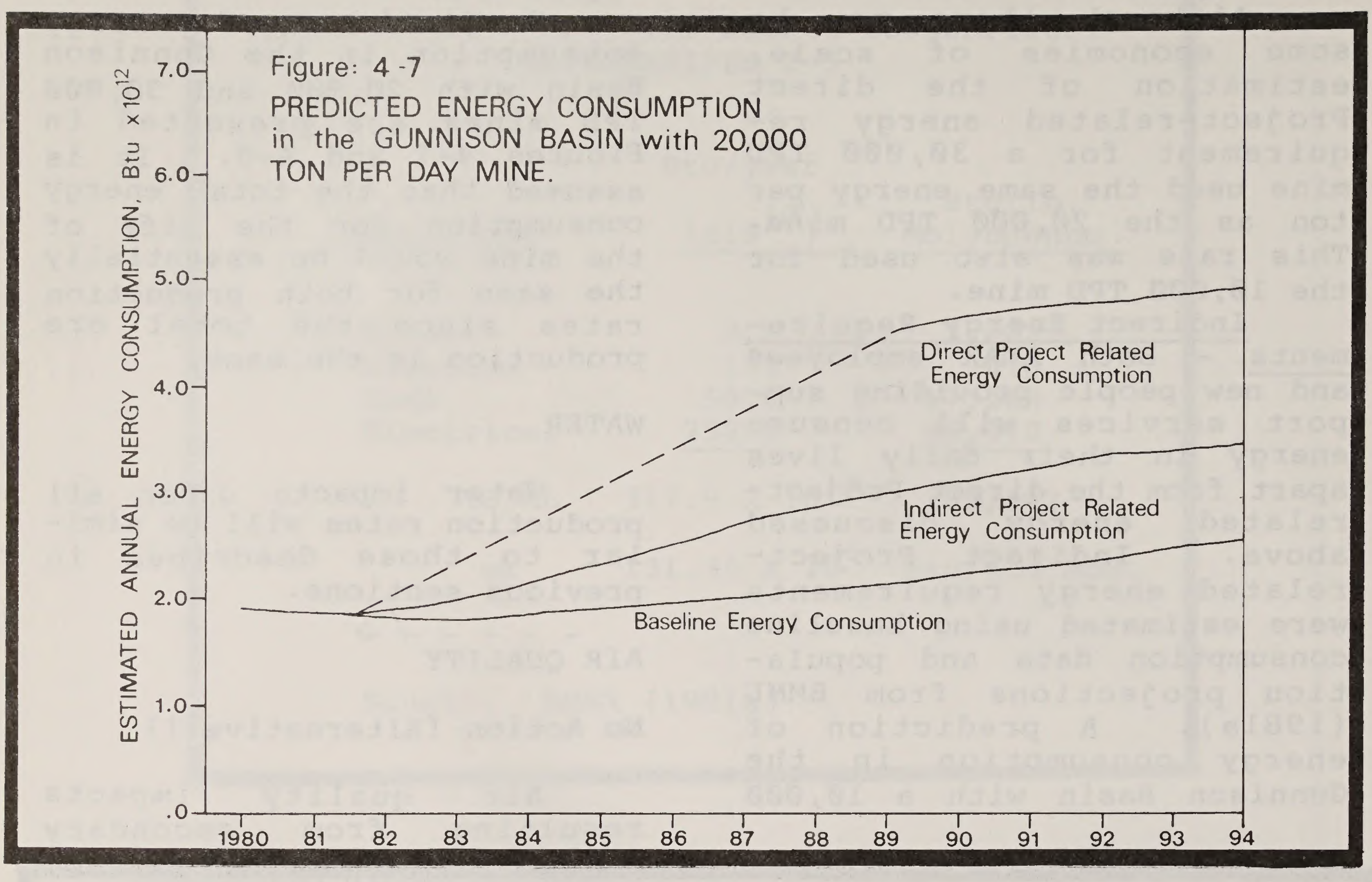


Figure: 4-7
PREDICTED ENERGY CONSUMPTION in the GUNNISON BASIN with 20,000 TON PER DAY MINE.

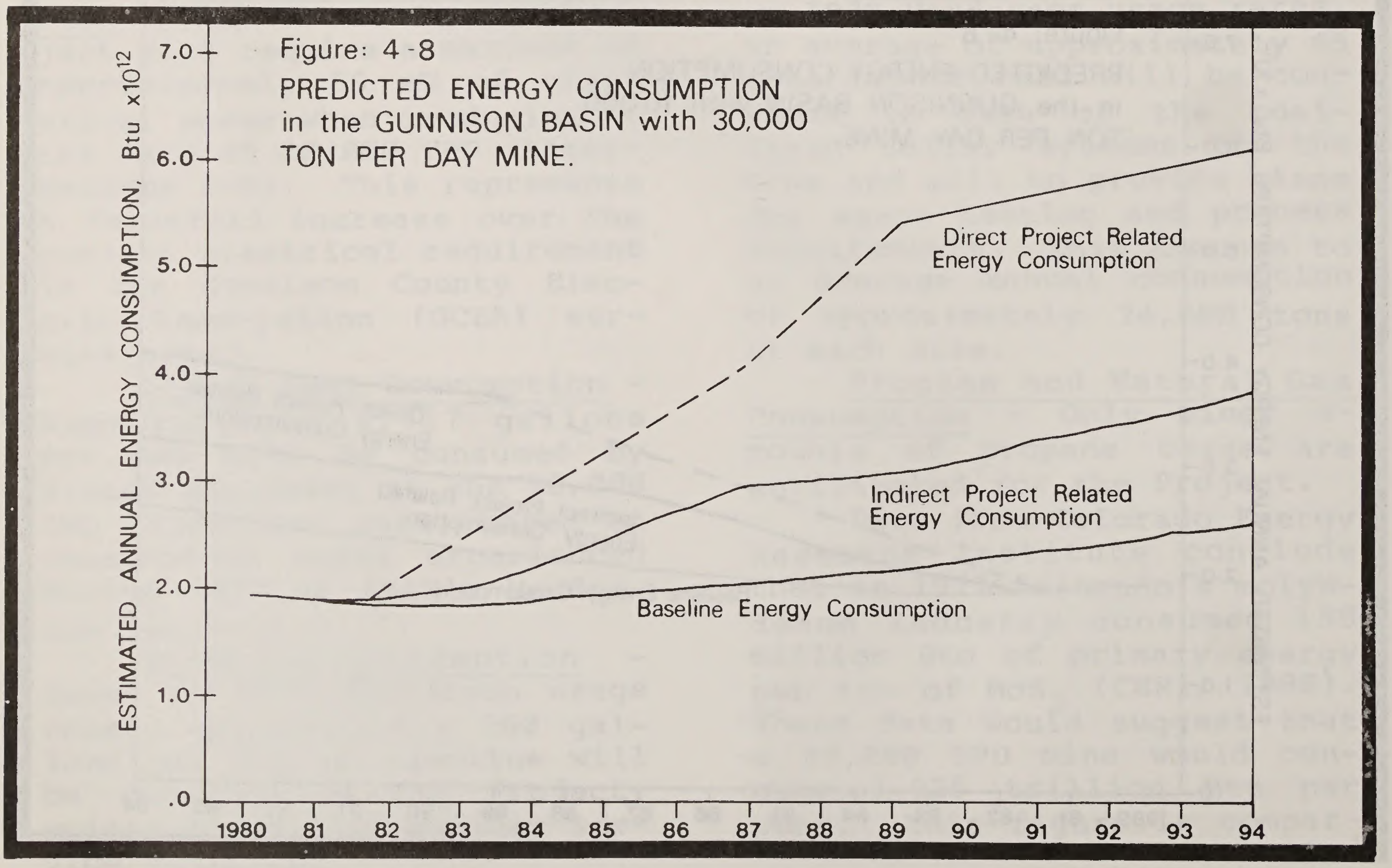


Figure: 4-8
PREDICTED ENERGY CONSUMPTION in the GUNNISON BASIN with 30,000 TON PER DAY MINE.

growth are included in the following discussions.

10,000 TPD (Alternative 6)

Population growth will tend to increase emissions into the atmosphere, primarily through burning wood and coal to heat homes, and through traffic volumes. The communities of Gunnison, the Town of Crested Butte, and Mt. Crested Butte will be the areas of largest impact.

The main pollutants of concern are total suspended particulates (TSP) and carbon monoxide (CO), but sulfur oxides and hydrocarbons will also be emitted. TSP emissions come from coal and wood combustion, vehicle exhausts, and dust generated by traffic on paved and unpaved roads. Carbon monoxide emissions come from vehicle exhausts and home heating.

CDM (1980u, 1981a) analyzed air quality impacts on TSP and CO resulting from population growth associated with the 10,000 TPD alternative (Alternative 6). Concentrations were calculated for the years 1986 and 1993, which span the period of growth. A comparison with air quality without the Mt. Emmons Project (Alternative 1) was also made. The results for TSP are summarized in Figure 4-9. This indicates that, by 1993, Gunnison air quality will be pressing against State/Federal standards, while in Crested Butte it will have exceeded the standards by a considerable margin. Under both alternatives, TSP contributions from either mine site will be negligible compared to indirect air impacts in the Town of Crested Butte. Air quality in Mt. Crested Butte will meet standards. Carbon monoxide concentrations will meet standards in all three communities.

Beach and Marlatt (1979) have also modelled anticipated air quality in the Gunnison area. Their results are somewhat lower than CDM's, due mainly to Beach and Marlatt's assumption that pollutants mix completely throughout the airshed.

The TSP concentrations shown in Figure 4-9 were calculated under the assumptions that the geographic size of the towns will not increase, and that existing unpaved streets will remain unpaved (CDM, 1981a). These concentrations could be lowered if the towns expanded their boundaries or if streets were paved. Modelling indicates that standards could be met in Gunnison and the Town of Crested Butte if all streets were paved (CDM, 1981a). Additional methods for reducing particulate emissions include mass transit, car pooling, changing the material used for street sanding, and controlling fireplace and stove emissions.

After 1993, air quality can be expected to deteriorate further with continued population growth unless steps are taken locally to control emissions. If local population drops following mine closure, air quality may improve.

20,000 TPD (Alternatives 2-5)

Air quality changes resulting from local population growth will be influenced by the same factors that were discussed for Alternative 6. But because population levels

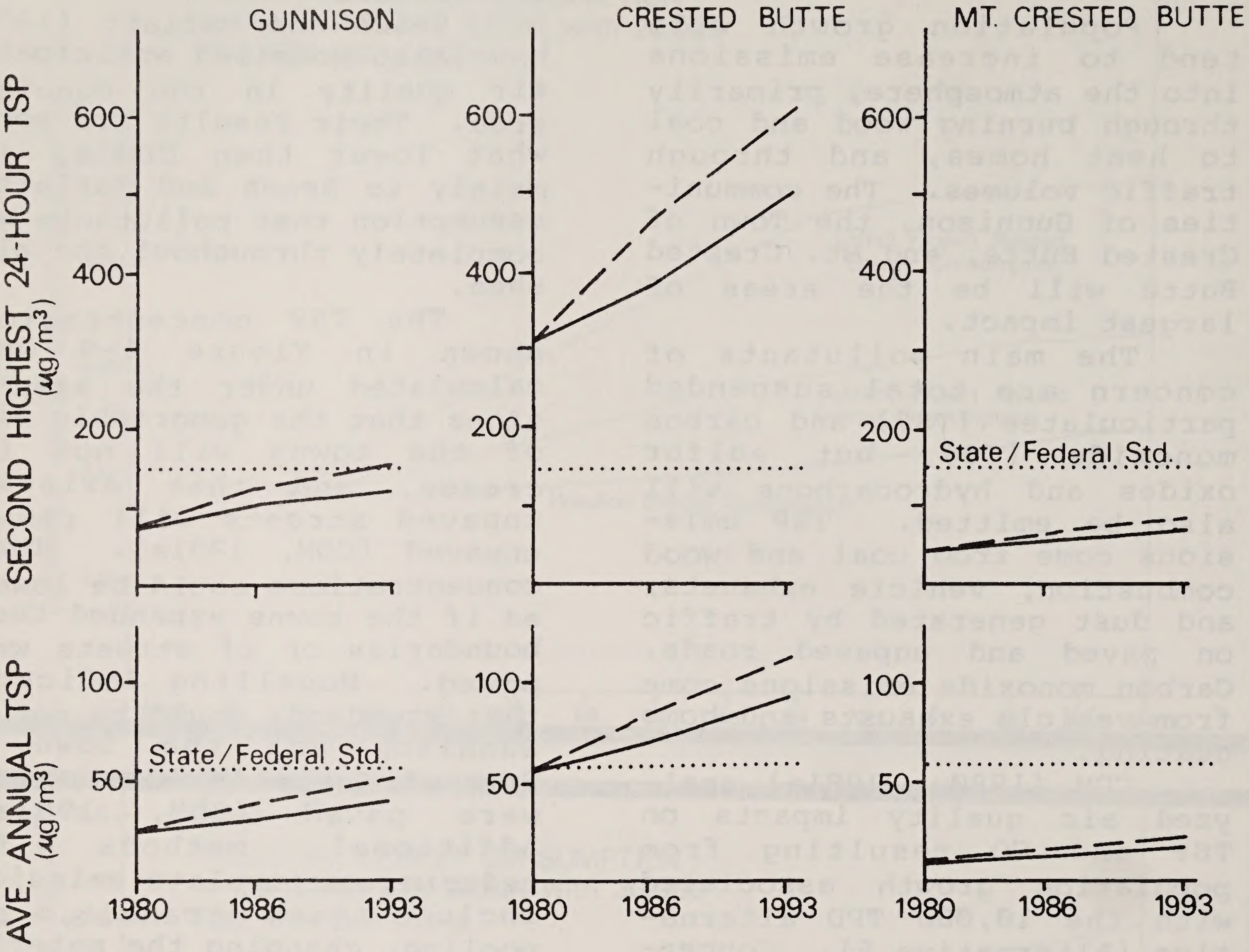


Figure: 4-9 AIR QUALITY FROM SECONDARY EMISSION SOURCES AT 10,000 TONS PER DAY (Solid line = without Mt. Emmons. Dashed line = with Mt. Emmons. Dotted line = State/Federal Standard.) source: CDM (1981a)

are higher, air quality is expected to be lower. Concentrations of TSP for Gunnison, the Town of Crested Butte, and Mt. Crested Butte are shown in Figure 4-10. Carbon monoxide is predicted to remain within standards (CDM, 1981a).

Air quality patterns beyond 1993 and through mine closure will resemble those discussed for Alternative 6.

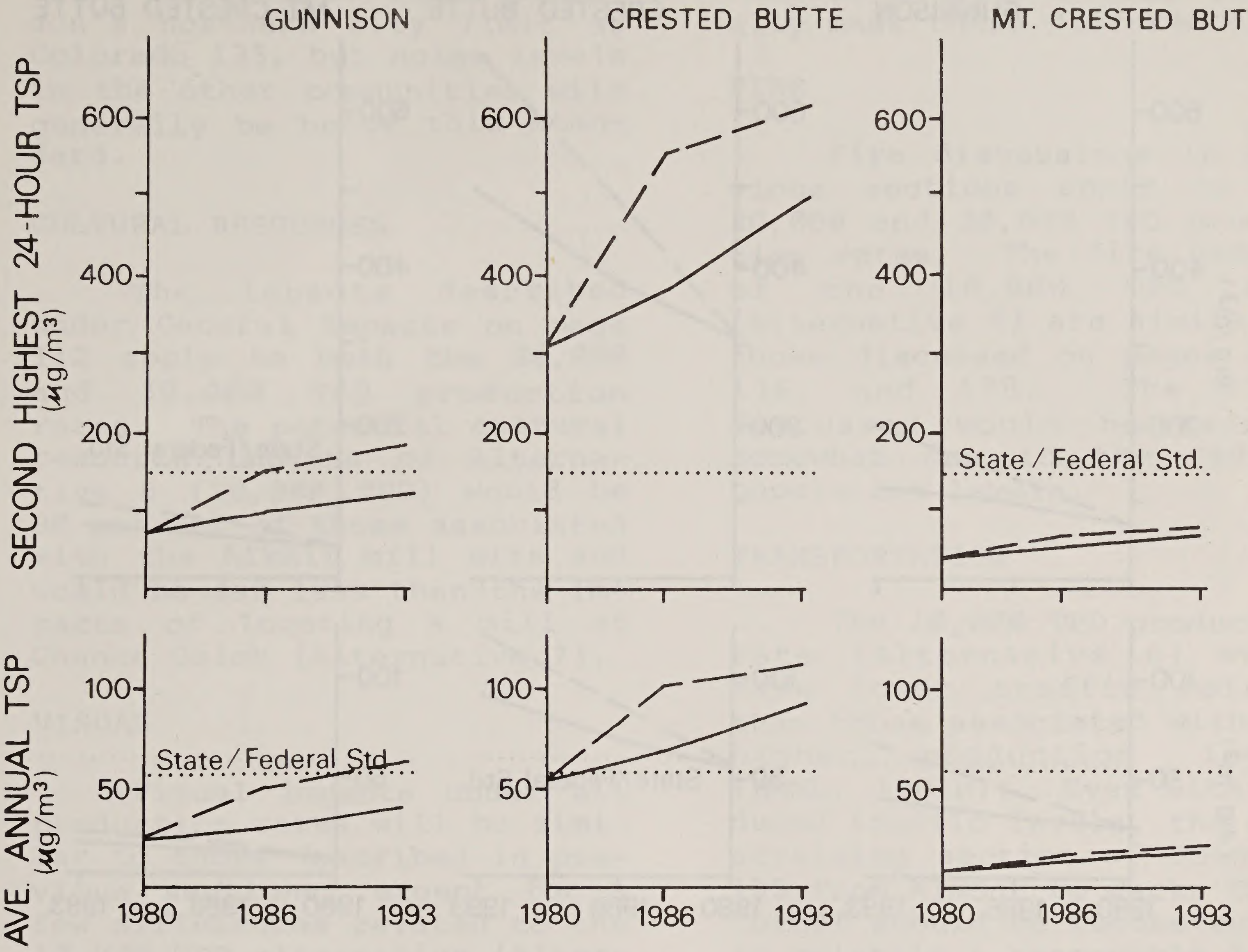


Figure: 4 - 10 AIR QUALITY FROM SECONDARY EMISSION SOURCES AT 20,000 TONS PER DAY (Solid line = without Mt. Emmons. Dashed line = with Mt. Emmons. Dotted line = State / Federal Standard.) source: CDM (1981a)

30,000 TPD (Alternative 7)

Air quality changes resulting from local population growth will be influenced by the same factors that were discussed for Alternative 6. But because population levels are higher, air quality is expected to be lower. Concentrations of TSP for Gunnison, the Town of Crested Butte, and Mt. Crested Butte are shown in Figure

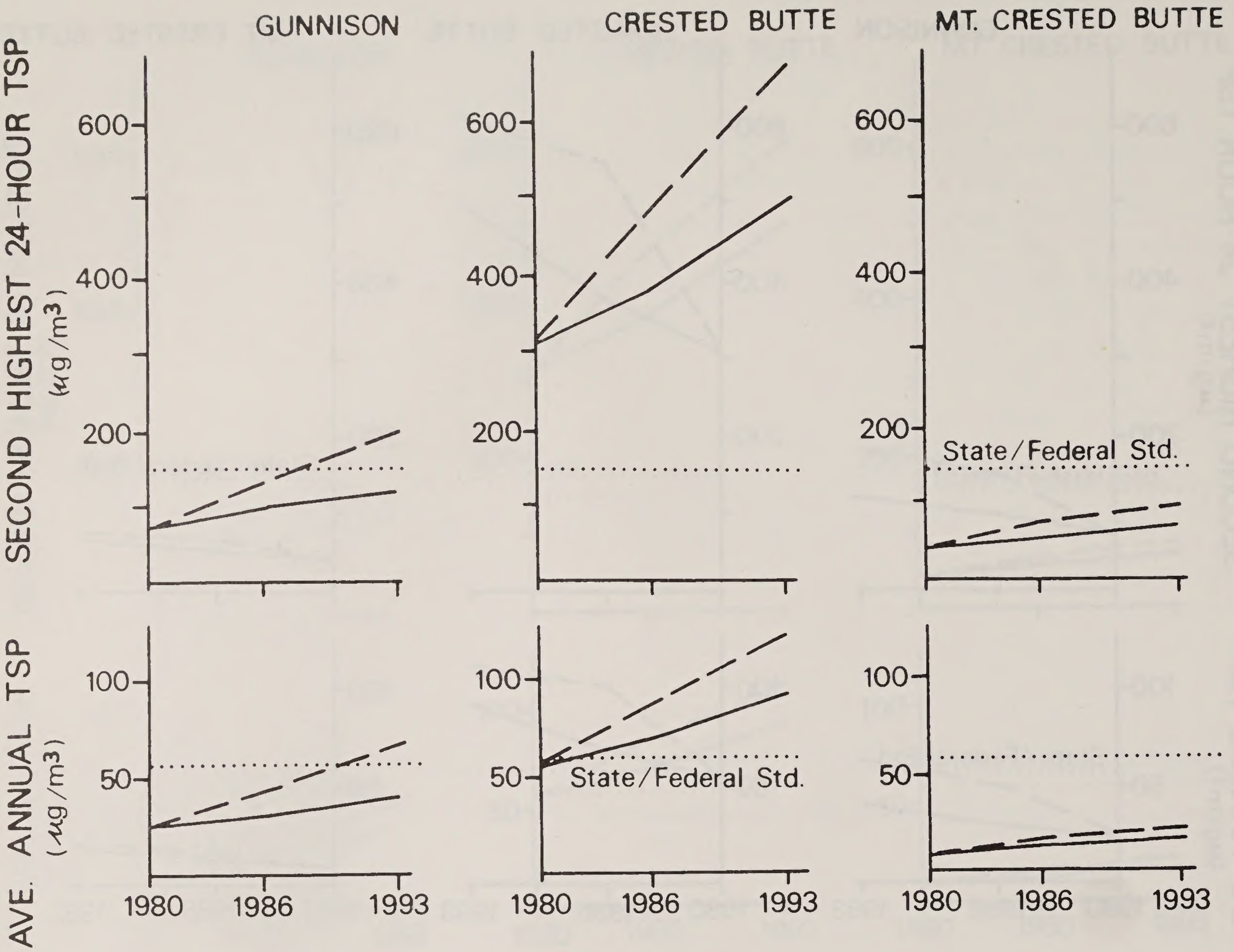


Figure: 4-11 AIR QUALITY FROM SECONDARY EMISSION SOURCES AT 30,000 TONS PER DAY (Solid lines = without Mt. Emmons. Dashed line = with Mt. Emmons. Dotted line = State/Federal Standard) source: CDM (1981a)

4-11. Carbon monoxide is predicted to remain within standards (CDM, 1981a).

Air quality patterns beyond 1993 and through mine closure will resemble those discussed for Alternative 6.

NOISE

The effects of growth under all alternatives will entail additional noise in communities. Mirabelli (1980) predicts average day-night noise increases of up to 4 dB in Gunnison, 1 dB in Almont, and 2 dB in the Town of Crested Butte. The Colorado residential standard of 55 dB will be reached near Gunnison's northern city limit at Colorado 135, but noise levels in the other communities will generally be below this standard.

CULTURAL RESOURCES

The impacts described under General Impacts on page 112 apply to both the 20,000 and 30,000 TPD production rates. The potential cultural resource impacts of Alternative 6 (10,000 TPD) would be 80 percent of those associated with the Alkali mill site and would be far less than the impacts of locating a mill at Chance Gulch (Alternative 7).

VISUAL

Visual impacts under all production rates will be similar to those described in previous sections, except for a few differences related to the 10,000 TPD alternative (Alternative 6). In that scenario, the mine site, mill site, and especially the tailing disposal area will be smaller. Their visual impacts will be less, but will still be of the same nature as discussed on pages 114 and 176. Subsidence is not expected to occur under 10,000 TPD (Alternative 6), and thus there should be no visual impacts near the top of Mt. Emmons.

OUTDOOR RECREATION

Impacts on outdoor recreation will be similar to those described in previous sections. They will be highest under the 30,000 TPD alternative (Alternative 7) and lowest under No Action (Alternative 1), but the influence of outside pressures will generally mask these differences.

FIRE

Fire discussions in previous sections apply to the 20,000 and 30,000 TPD production rates. The fire hazards of the 10,000 TPD rate (Alternative 6) are similar to those discussed on pages 126, 136, and 178. The risks discussed would be reduced somewhat due to the reduced population levels.

TRANSPORTATION

The 10,000 TPD production rate (Alternative 6) would have lower traffic volumes than those associated with the higher production levels (BMML, 1981b). Even with reduced traffic levels, the constraining section of Colorado 135 from Almont to Jacks Cabin Cutoff should be reconstructed to maintain a reasonable level of service.

Associated with the lower traffic volumes of Alternative 6 would be approximately 33 percent fewer expected accidents expected on Colorado 135.

SOCIOECONOMICS

If the Mt. Emmons ore body is mined, accelerated growth will occur under all alternative production rates. Because of this, socioeconomic impacts will differ from each other mainly in degree rather than nature. All of the production scenarios will require accommodation by existing social and economic systems, and for this reason the three production rates are analyzed collectively. A summary of their impacts has been extracted from BMML (1981 a-d) and is presented below.

(The following predictions are only 'best guesses' of what will happen because of the uncertainties involved. For example, construction schedules will be different from those analyzed by BMML in its studies, and the rate at which people move into the area may be different. However, while BMML's predictions may be off in actual numbers, they still address the types and magnitudes of impacts expected.)

A system of monitoring growth will be needed to 'fine tune' community responses to development pressures. AMAX proposed methods for accomplishing this (Appendix A, pages A-1 to A-17).

Population

A major driving force underlying socioeconomic impacts is population, which is directly influenced by AMAX employees who will move into the area. Employee requirements are shown in Figure 4-12. Projected population for Gunnison County is shown in Figure 4-13, and for the City of Gunnison in Figure 4-14. The estimated growth rates associated with these figures are listed in Tables 4-46 and 4-47, respectively.

(As discussed by BMML (1981a) and Snider (1981), current population figures vary from source to source, and population projections hinge on assumptions that may or may not become reality. Nonetheless, the projected figures serve as a guide for planning growth management.)

Spatial Allocation

Projections made by BMML (1981a, c, d), in cooperation with representatives of local governments, the Forest Service, and AMAX indicate that population growth will concentrate in the Gunnison area under all alternatives, (Table 4-48 on page 214). These projections were made subject to the following assumptions:

(1) Growth initially will take the path of least resistance; people will go where affordable housing is or will be available, surroundings are attractive, and basic services and amenities are available.

(2) New housing development will initially occur where public services are available, vacant developable land is available, and development costs and complications are the least.

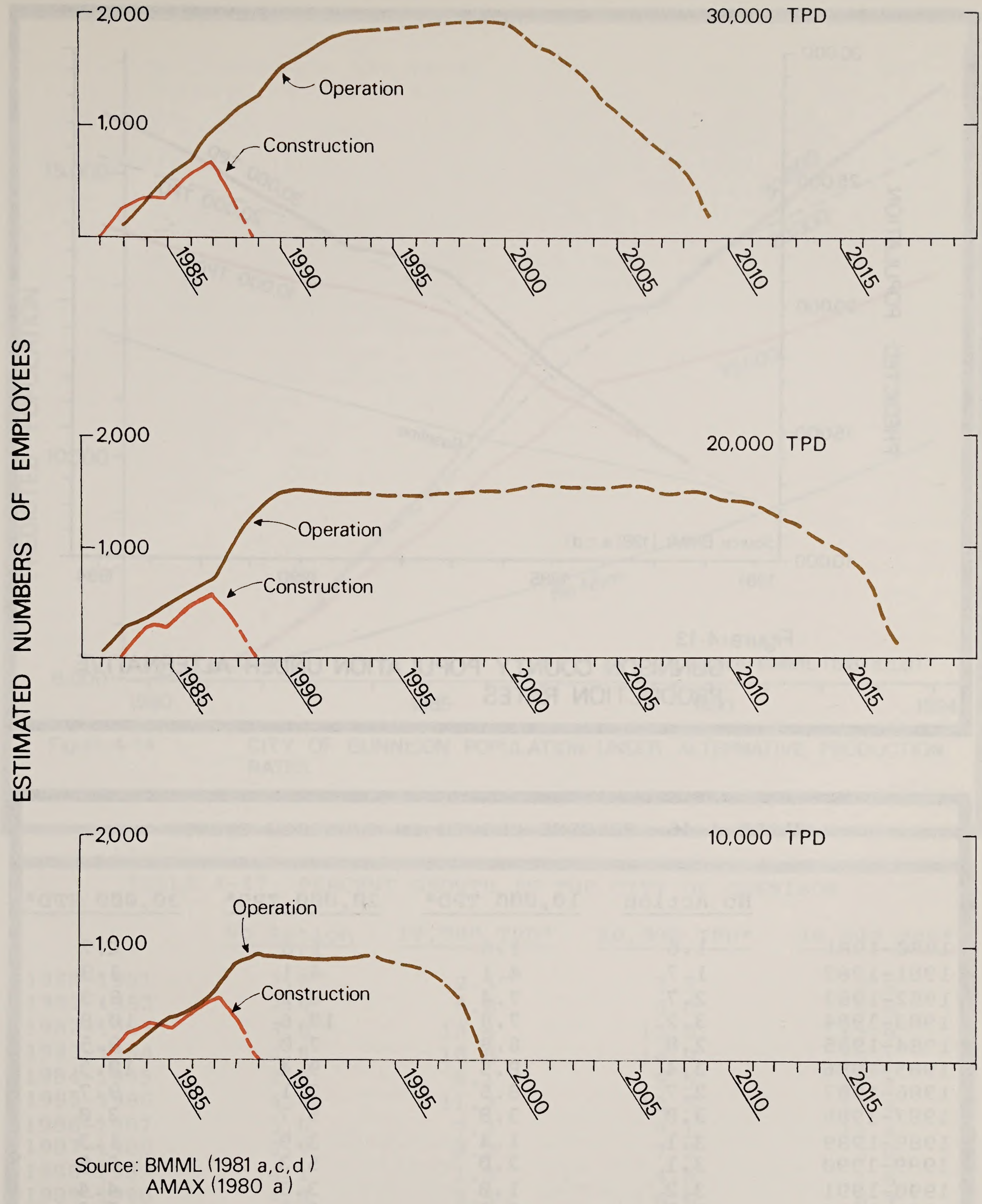
(3) Proposed new communities cannot accommodate new housing right away; it will take at least two years to get the first houses in a new development on the market.

(4) Some scattered rural development will occur, and will appeal to both permanent and seasonal residents.

(5) Permanent residents will desire a high level of services and amenities, such as health services, shopping variety, parks, and recreation programs.

(6) New secondary jobs will be located in areas where urban concentrations of development currently exist.

(7) New households related to secondary jobs will pri-



Source: BMML (1981 a,c,d)
AMAX (1980 a)

Figure: 4-12 Employee Requirements for Alternative Production Rates

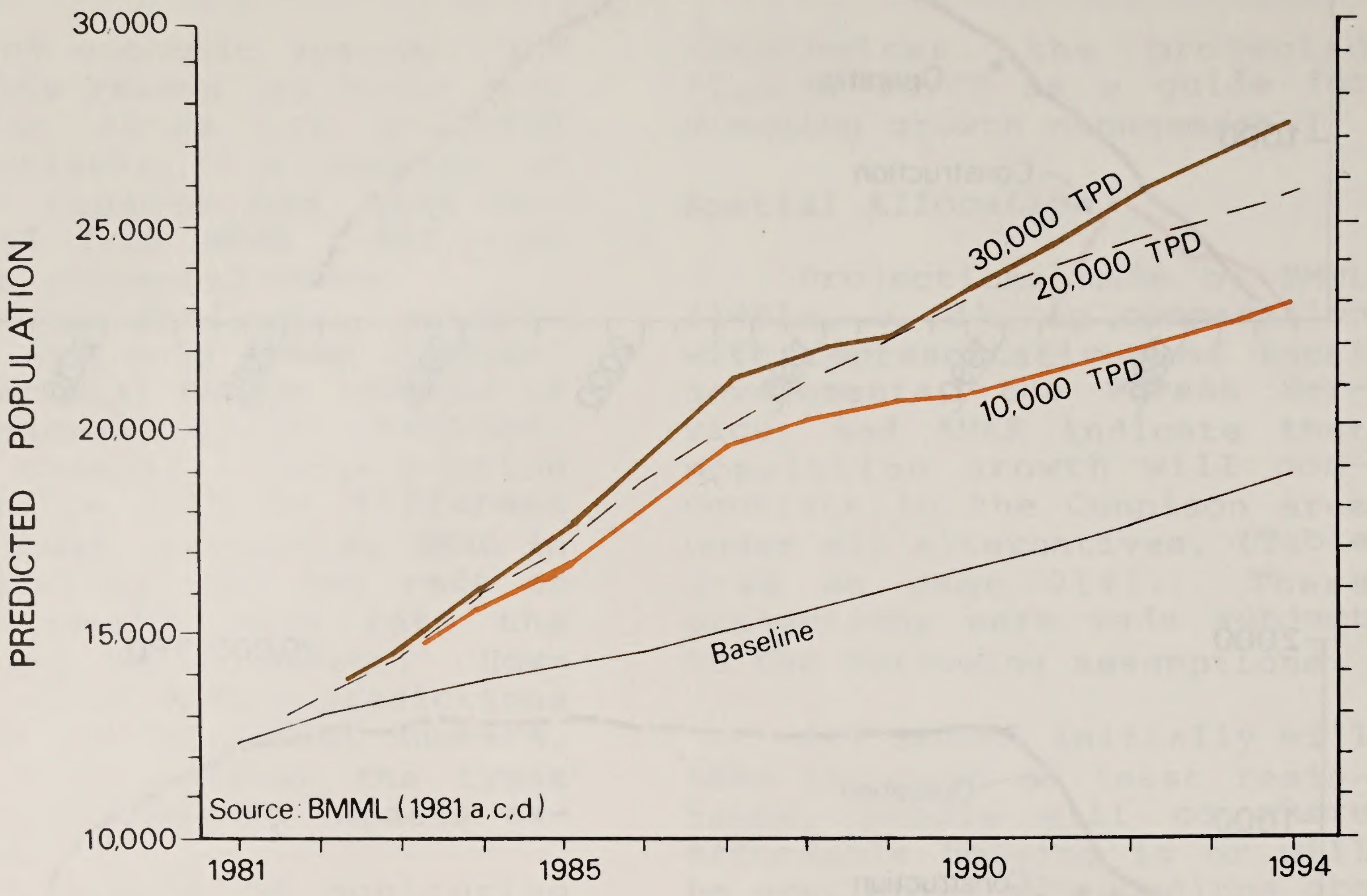


Figure: 4-13

GUNNISON COUNTY POPULATION UNDER ALTERNATIVE PRODUCTION RATES

TABLE 4-46 PERCENT GROWTH IN GUNNISON COUNTY

	No Action	10,000 TPD*	20,000 TPD*	30,000 TPD*
1980-1981	1.6	1.6	1.6	1.7
1981-1982	1.7	4.1	4.1	3.8
1982-1983	2.7	7.4	8.2	8.9
1983-1984	3.2	7.9	10.6	10.8
1984-1985	2.8	6.8	7.0	8.5
1985-1986	3.4	8.5	9.4	10.3
1986-1987	2.7	8.5	7.1	9.7
1987-1988	3.0	3.8	5.7	3.0
1988-1989	3.1	1.4	3.9	1.3
1989-1990	3.1	2.0	5.3	5.5
1990-1991	3.2	1.8	3.3	4.4
1991-1992	3.5	2.5	2.6	5.2
1992-1993	3.4	2.7	2.2	4.0
1993-1994	3.6	2.8	2.5	3.4

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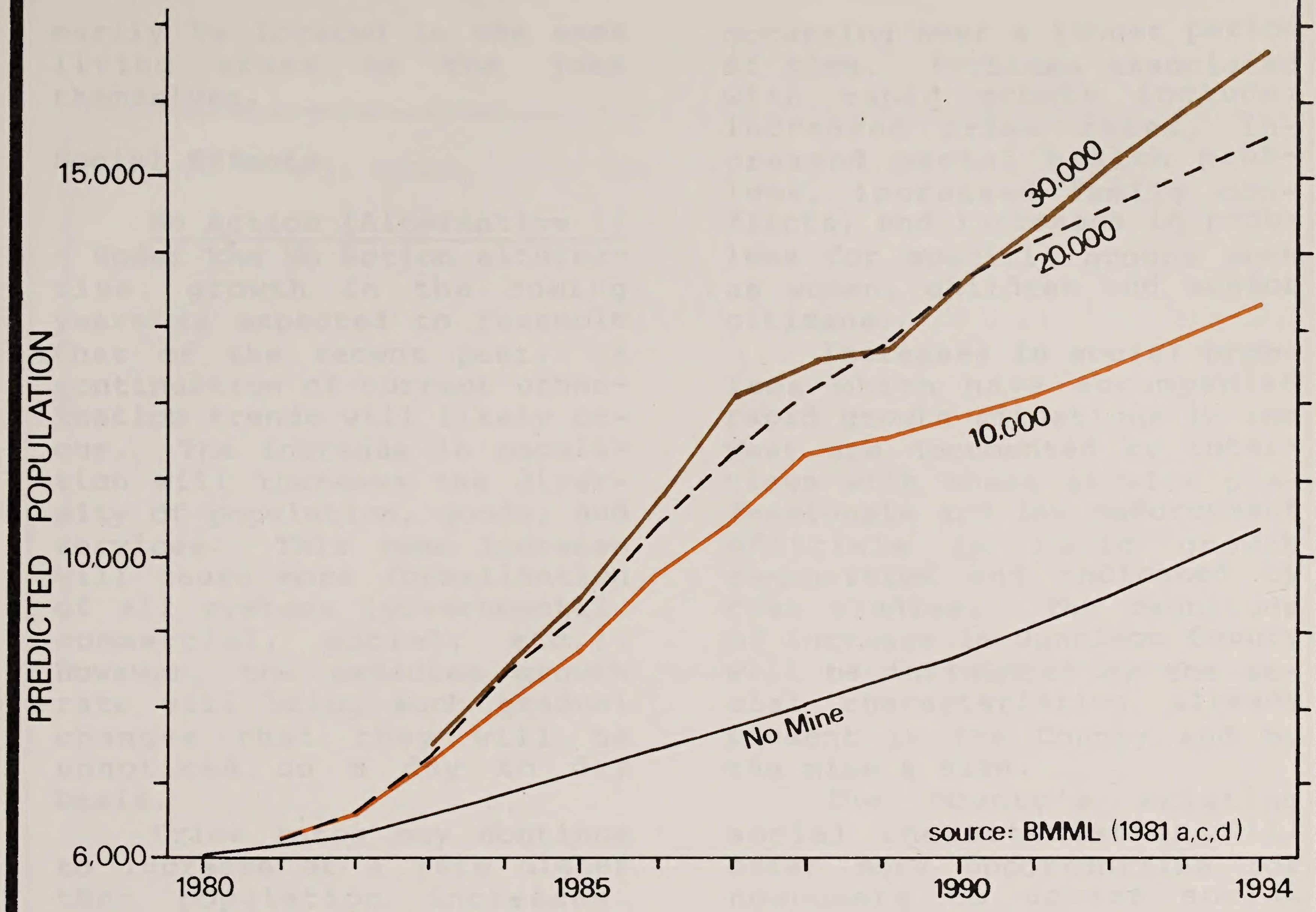
*TPD = Tons per day

Source: BMML (1981a, c, d)



source: BMML (1981 a,c,d)

Figure: 4-14 CITY OF GUNNISON POPULATION UNDER ALTERNATIVE PRODUCTION RATES.

TABLE 4-47 PERCENT GROWTH IN THE CITY OF GUNNISON

	No Action	10,000 TPD*	20,000 TPD*	30,000 TPD*
1980-1981	2.2	2.3	2.3	2.5
1981-1982	2.4	5.8	6.0	5.6
1982-1983	3.8	10.4	12.0	12.9
1983-1984	4.4	10.8	14.9	15.1
1984-1985	3.9	9.1	9.5	11.4
1985-1986	4.6	11.2	12.5	13.4
1986-1987	3.6	7.3	9.1	12.4
1987-1988	3.9	8.2	7.2	3.8
1988-1989	4.1	1.8	4.8	1.6
1989-1990	4.0	2.5	6.6	6.7
1990-1991	4.1	2.2	4.0	5.6
1991-1992	4.5	3.0	3.2	6.0
1992-1993	4.3	3.3	2.7	4.7
1993-1994	4.5	3.4	3.1	4.0

*TPD = Tons per day

Source: BMML (1981a, c, d)

marily be located in the same living areas as the jobs themselves.

Social Effects

No Action (Alternative 1) - Under the No Action alternative, growth in the coming years is expected to resemble that of the recent past. A continuation of current urbanization trends will likely occur. The increase in population will increase the diversity of population, goods, and services. This same increase will cause more formalization of all systems (governmental, commercial, social, etc.). However, the expected growth rate will bring such gradual changes that they will be unnoticed on a day to day basis.

Crime rates may continue to increase at a rate higher than population increases. This is in line with Statewide trends. Human service caseloads may increase at a rate higher than population increases.

10,000-30,000 TPD (Alternatives 2-7) - Additional social impacts brought about by the three alternative production rates stem from the following factors: (1) accelerated growth rates, shown in Tables 4-46 and 4-47, and (2) the values held by current residents regarding the quality of their physical and social environment.

The present urbanization trend described above will be accelerated. Even under the best of circumstances, it appears that rapid growth produces a higher number of emotional and life stress problems than would a comparable increase in population occurring over a longer period of time. Problems associated with rapid growth include: increased crime rates, increased mental health problems, increased family conflicts, and increases in problems for specific groups such as women, children and senior citizens.

Increases in social problems which have accompanied rapid growth situations in the West are documented by interviews with human service professionals and law enforcement officials in rapid growth communities and indicated by case studies. The magnitude of increase in Gunnison County will be influenced by the social characteristics already present in the County and by the mine's size.

The county's existing social characteristics will offer more opportunities for newcomers to access social support systems than those areas that are centered around relatively static single-industry communities. The availability of social support systems significantly reduces the rate of increase in social problems. However, the rate of growth during the construction years may cause those systems to become overloaded. If these systems become increasingly difficult to access, newcomers will become increasingly alienated and socially isolated. Long-time residents experience similar effects as their social support systems change and become increasingly dysfunctional. Correspondingly, social problems increase at an accelerating rate.

Gunnison County residents generally place a high value on various aspects of their

TABLE 4-48. SPATIAL ALLOCATION OF RESIDENTS IN 1994

	No Action	10,000 TPD	20,000 TPD	30,000 TPD
City of Gunnison	10,320	13,286	15,471	16,608
Gunnison Fringe	2,398	2,719	3,062	3,035
Town of Crested Butte	1,932	2,279	2,322	2,537
Mt. Crested Butte	431	524	504	583
Remainder of County	3,839	4,217	4,338	4,658
TOTAL	18,920	23,024	25,697	27,421

Source: BMML (1981a, c, d)

physical and social environment. These are sometimes collectively referred to as the 'quality of life', which is not subject to simple definition. A major local concern regarding the Mt. Emmons Project is that this 'quality of life' may be damaged. A prediction on this cannot be made. BMML (1981b, Section 13) developed a method for using factual information to help in the analysis of nonmarketable effects. The discussions in this draft EIS focus on subjects that are more definitive than the term 'quality of life'.

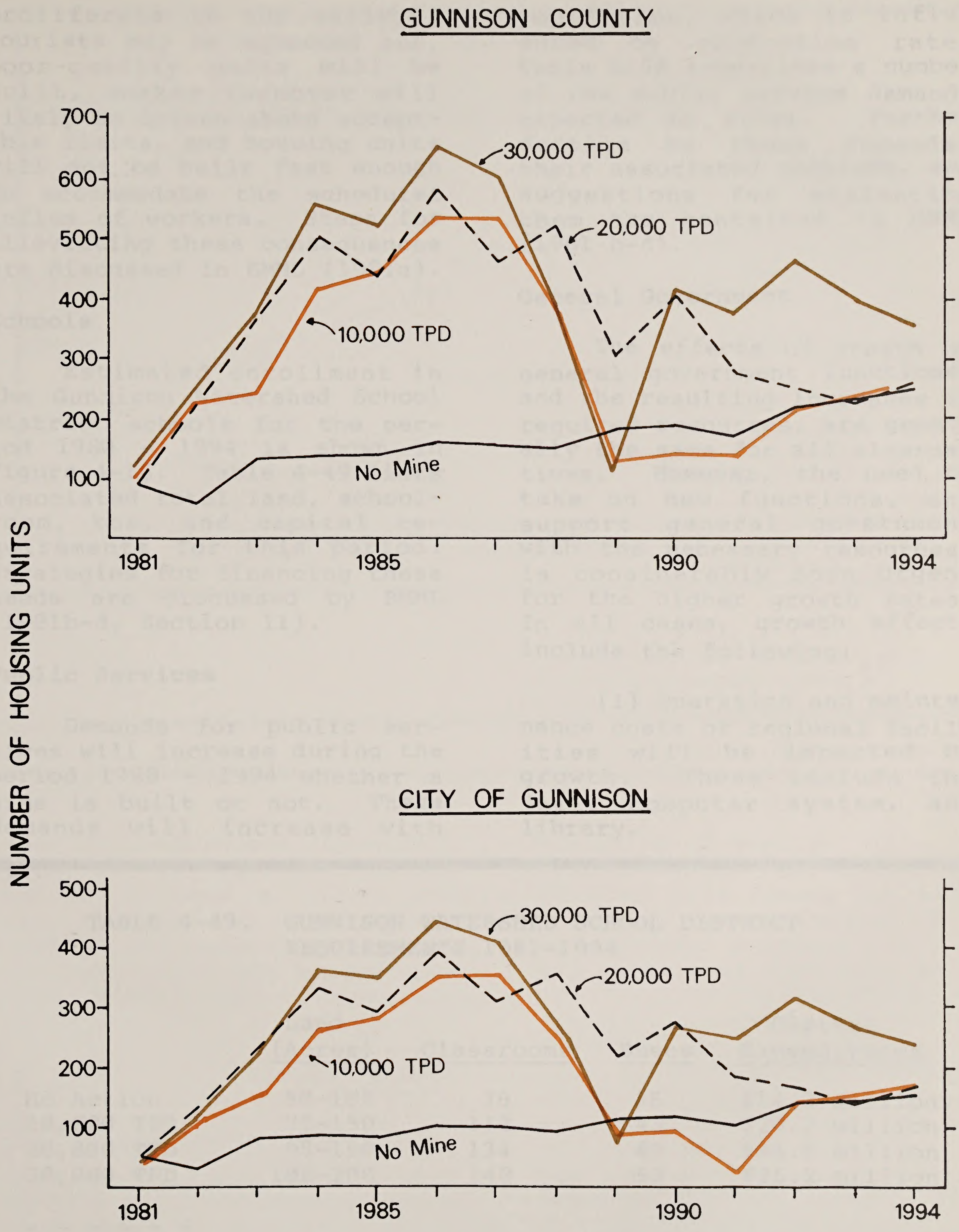
Tradeoffs - Alternatives 2-7 could potentially have negative effects on the social environment in Gunnison County, as discussed above. At the same time, these alternatives could improve certain deficiencies that already exist, such as limited shopping facilities, low wages, shortage of employment opportunities, and limited indoor recreational facilities.

Housing

The new housing units needed each year for Gunnison County and the City of Gunnison are shown in Figure 4-15. About a hundred new units a year are needed even without a mine (Alternative 1), but under any of the production alternatives the numbers become substantially greater.

Approximately 500 acres of land will be needed for housing under Alternative 1, and under the production alternatives the area needed will be 2 or 3 square miles. (The present area of the City of Gunnison is about 1 square mile.) Before new housing is built in wetland areas, as identified by the Army Corps of Engineers, a Section 404 Dredge and Fill Permit from the Corps will be required.

The local housing market is tight, and if positive actions are not taken soon to create new, affordable housing, it will become tighter. Mobile home parks will likely


GUNNISON COUNTY

CITY OF GUNNISON

Figure: 4-15 NEW HOUSING UNITS NEEDED UNDER ALTERNATIVE PRODUCTION RATES.

source: BMML (1981 a,c,d)

proliferate in the valleys, tourists may be squeezed out, poor-quality units will be built, worker turnover will likely be driven above acceptable limits, and housing units will not be built fast enough to accommodate the scheduled influx of workers. Steps for alleviating these consequences are discussed in BMML (1981a).

Schools

Estimated enrollment in the Gunnison Watershed School District schools for the period 1980 - 1994 is shown in Figure 4-16. Table 4-49 lists associated total land, schoolroom, bus, and capital requirements for this period. Strategies for financing these needs are discussed by BMML (1981b-d, Section 11).

Public Services

Demands for public services will increase during the period 1980 - 1994 whether a mine is built or not. These demands will increase with population, which is influenced by production rate. Table 4-50 summarizes a number of the public service demands expected to arise. Further details on these demands, their associated problems, and suggestions for mitigating them are contained in BMML (1981 b-d).

General Government

The effects of growth on general government functions, and the resulting increases in required resources, are generally the same for all alternatives. However, the need to take on new functions, and support general government with the necessary resources, is considerably more urgent for the higher growth rates. In all cases, growth effects include the following:

(1) Operation and maintenance costs of regional facilities will be impacted by growth. These include the jail, computer system, and library.

TABLE 4-49. GUNNISON WATERSHED SCHOOL DISTRICT REQUIREMENTS 1981-1994

	Land (Acres)	Classrooms	Buses	Capital Expenditures
No Action	50-100	78	35	$14.3 million
10,000 TPD	75-150	112	43	$20.2 million
20,000 TPD	95-190	134	49	$24.0 million
30,000 TPD	100-200	148	52	$26.2 million

- - - - - - -

Source: BMML (1981b, c, d)

TABLE 4-50 PUBLIC SERVICE REQUIREMENTS

	1980	Total Needed by 1994			
	Level	No Action	10,000 TPD	20,000 TPD	30,000 TPD
Police Officers					
Gunnison County	14	18	21	23	24
City of Gunnison	12	21	28	33	35
Crested Butte	4	6	6	6	6
Mt. Crested Butte	6	16	16	16	16
Fire Volunteers					
Gunnison District	36	54	66	76	81
Crested Butte	24	57	59	59	60
Developed Park (Acres)	20	132	161	181	192
Landfill (Acres)	**	107	123	136	146
Hospital beds	24	43	55	63	68
Water Supply	- - - -	- - - -	Adequate	- - - -	- - - -
Sewage Treatment Capacity* (MGD)	2.2	4.3	4.5	5.6	6.1

---

* Required by the year 2000.
** 3-6 years capacity remaining.
MGD = million gallons per day.

Source: BMML (1981B-D)

(2) Increased planning and regulatory responsibilities and growth will increase staff requirements.

(3) Gunnison and Crested Butte Town Hall facilities are now at capacity.

(4) Demands on general government functions will be impacted by the visitor population in Mt. Crested Butte and the Town of Crested Butte.

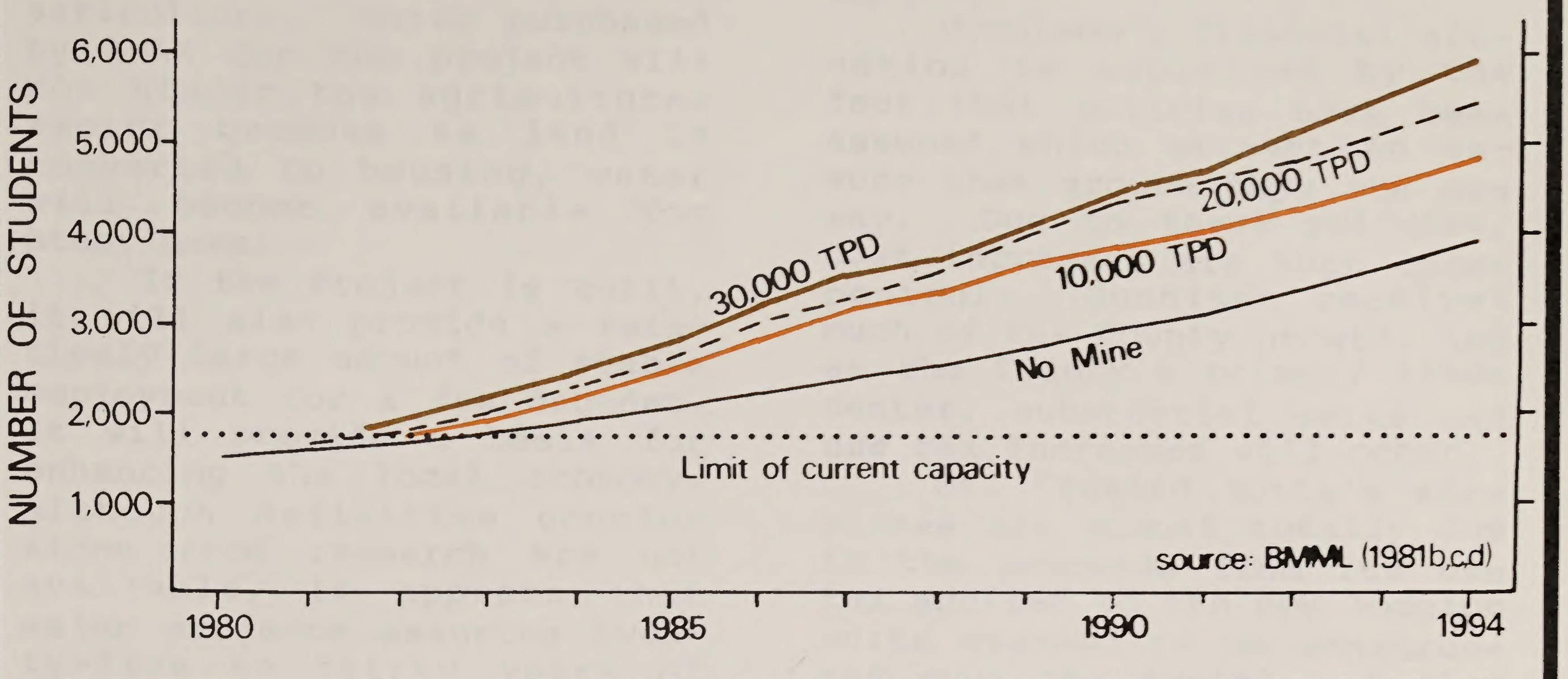
(5) The library is currently below standards, and with growth its inadequacies will become more apparent.

In all growth alternatives, mitigation will require effective use of potential tax resources that pay for general government functions. In particular, the use tax and sales tax could be used to assure availability of adequate tax revenues. A specific countywide system for these taxes is discussed in BMML (1981b, Section 11.3).

Fiscal Impacts

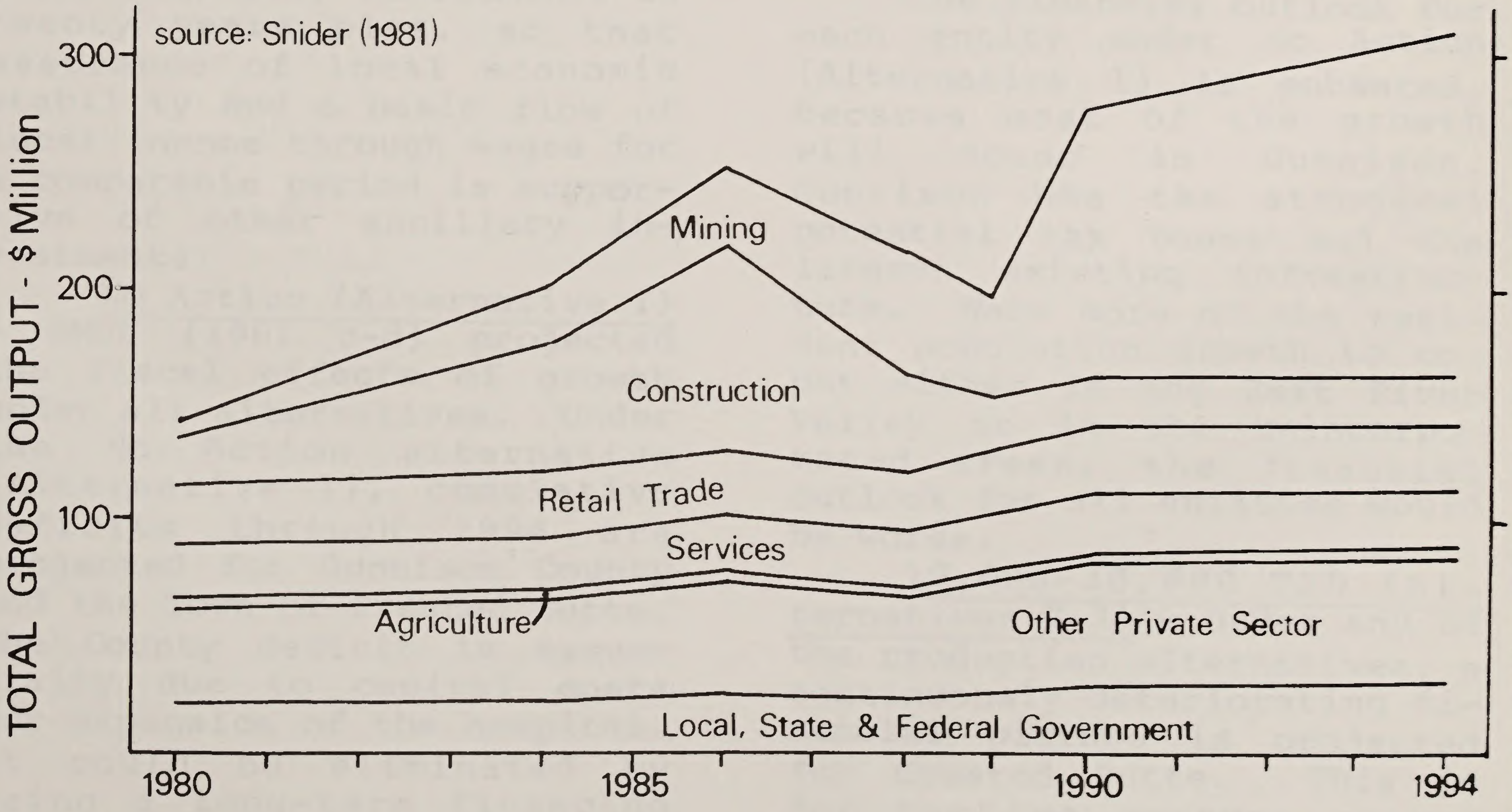
General - If the mine is built the Gunnison trade area's total gross output will increase substantially (Figure 4-17). Revenue to local governments will similarly rise through sales and property taxes.

Some agricultural land will be taken out of produc-



source: BMML (1981b,c,d)

Figure: 4-16 ESTIMATED SCHOOL ENROLLMENT IN GUNNISON WATERSHED SCHOOL DISTRICT UNDER ALTERNATIVE PRODUCTION RATES.



source: Snider (1981)

Figure: 4-17 TOTAL GROSS OUTPUT WITH MT. EMMONS AT 20,000 TONS DAY (1978 Dollars)

tion to serve housing needs. This is not expected to have a pronounced negative effect on agriculture. Water purchased by AMAX for the project will not hinder the agricultural sector because as land is converted to housing, water will become available for other uses.

If the Project is built, it will also provide a relatively large amount of stable employment for a few decades. It will provide a basis for enhancing the local economy. Although definitive conclusions from research are not available, it appears that major projects assuring twenty-five to thirty years of continuous employment provide a better base for local economic development than projects with a life less than twenty years, or ones exhibiting uncertain job security over the period. This is because the minimum payout period for many investments is twenty years plus, so that assurance of local economic stability and a basic flow of local income through wages for a comparable period is supportive of other ancillary investments.

No Action (Alternative 1) - BMML (1981 b-d) projected the fiscal effects of growth under all alternatives. Under the No Action alternative (Alternative 1), cumulative deficits through 1994 are projected for Gunnison County and the Town of Crested Butte. The County deficit is essentially due to capital costs for expansion of the hospital. It could be eliminated by using a long-term financing method for payment. Crested Butte's deficits indicate that current costs of service levels cannot be sustained within the limits of the Town's tax base.

Gunnison's financial situation is explained by the fact that policies have been assumed which attempt to assure that growth pays its own way. Due to these policies, cost increases are kept under control. Gunnison receives much of the County growth, and as the County's primary trade center, substantial sales and use tax increases will occur.

Mt. Crested Butte's surpluses are almost totally due to the proceeds from its use tax applied to the new lodging units assumed to be constructed over the period. A slow year or tight money could have a major impact on the flow of revenue. This will become particularly critical as Mt. Crested Butte assumes the responsibility for more or higher levels of public services.

The financial outlook for each entity under No Action (Alternative 1) is enhanced, because most of the growth will occur in Gunnison. Gunnison has the strongest potential tax bases and the largest existing infrastructure. Were more of the resident population growth to occur either in the East River Valley or in the unincorporated areas, the financial outlook for all entities would be worse.

10,000-30,000 TPD (Alternatives 2-7) - Under any of the production alternatives, a continuously deteriorating financial picture is projected for Crested Butte. This is for the two reasons stated above: high service costs and a weak tax base. Without major changes in one or both of the factors, resident population growth is simply not affordable. By 1994, and regardless of production rate, the projected cumulative deficit is about $1.5 million more than the No Action figure of $1 million (BMML, 1981b).

In the long run, Gunnison County would financially benefit from the development of the Project through property tax growth. Although a large cumulative deficit is shown through 1989, this could be alleviated in part by long-term financing of the hospital expansion, other capital improvements, or introduction of non-County funds. If this were accomplished, the County would still likely have a lead time problem, but would eventually find itself in a surplus at current tax rates.

The City of Gunnison will experience some short-term problems financing expanded capital needs, but overall does well enough with sales, use, and property taxes, to eventually develop cumulative surpluses.

Mt. Crested Butte's picture is roughly the same as with No Action (Alternative 1), as it is assumed to absorb little residential population growth due to the mine.

Eventually, fiscal vitality for the towns must come through strengthening the local economies. Property values, retail sales, and personal incomes are the keys to local public financial health, and raising these is a long-term proposition. In addition, the development that occurs must be such that it can be served efficiently and with economies of scale. Economic development is an issue to be considered by the town councils in the County. Land use policies should support the development of commercial activities in the towns.

For the short term, belt-tightening is the solution to budgets that are in excess of funds available. As considerations for long-term solutions, BMML has offered numerous mitigation methods that could be used to cope with expected growth (BMML, 1981 a-d).

Of immediate importance, however, is getting started. The lead times required to plan and build public service systems and housing are such that as much as two years may be needed to complete some projects. If systems are not on stream by the time they are needed, it could ironically turn out that in spite of all the forwarnings, the 'boom-town' syndrome could appear once again.

AMAX Costs

The estimated capital costs of the three production rates can only be compared in general terms. Based on the assessed valuations listed in BMML (1981 a, c, d), the capital costs of the 10,000 TPD, 20,000 TPD, and 30,000 TPD rates are $408 million, $650 million, and $778 million, respectively, in 1980 dollars. The costs for the latter two will vary somewhat according to configuration as discussed in previous sections. The rate of return is not estimated.

Mine Closure

The mine will close. Even if new ore is discovered and the mine's life is prolonged, it will still close eventually.

This event has brought severe hardship on some communities heavily influenced by mining. Unemployment, bankruptcy and out-migration have been common.

It cannot be predicted with confidence that a 'bust' will not follow closure of the Mt. Emmons mine, but neither will a 'bust' definitely occur.

The greatest likelihood of a 'bust' would accompany the 10,000 TPD alternative (Alternative 6). With a mine life of about 12 years, the local economy might not have time to develop other industries that could help absorb workers during closure.

Several factors suggest that closure could be comparatively mild:

(1) It is not expected to be abrupt. The end of production will be known several years ahead of time.

(2) Layoffs should be minimal. Among AMAX's mitigations in Appendix A (page 270) is the proposal to reduce the workforce during closure by not filling jobs as they are vacated.

(3) Time should be available for community planning. If closure is known several years in advance, local governments will have time to prepare, and this should ease the transition to a post-mine economy.

GEOLOGY

Geologic Hazards under all alternatives will be similar to those described in previous sections.

SOILS

Soils impacts under all alternatives will be similar to those described in previous sections.

LAND USES

Land use discussions in previous sections apply to the 20,000 and 30,000 TPD production rates. The impacts under 10,000 TPDD would still occur, but the level of impact would be less, approximately in proportion to population differences.

AVALANCHE HAZARDS

Avalanche hazards under all alternatives are similar to those described in previous sections.

POWER SUPPLY

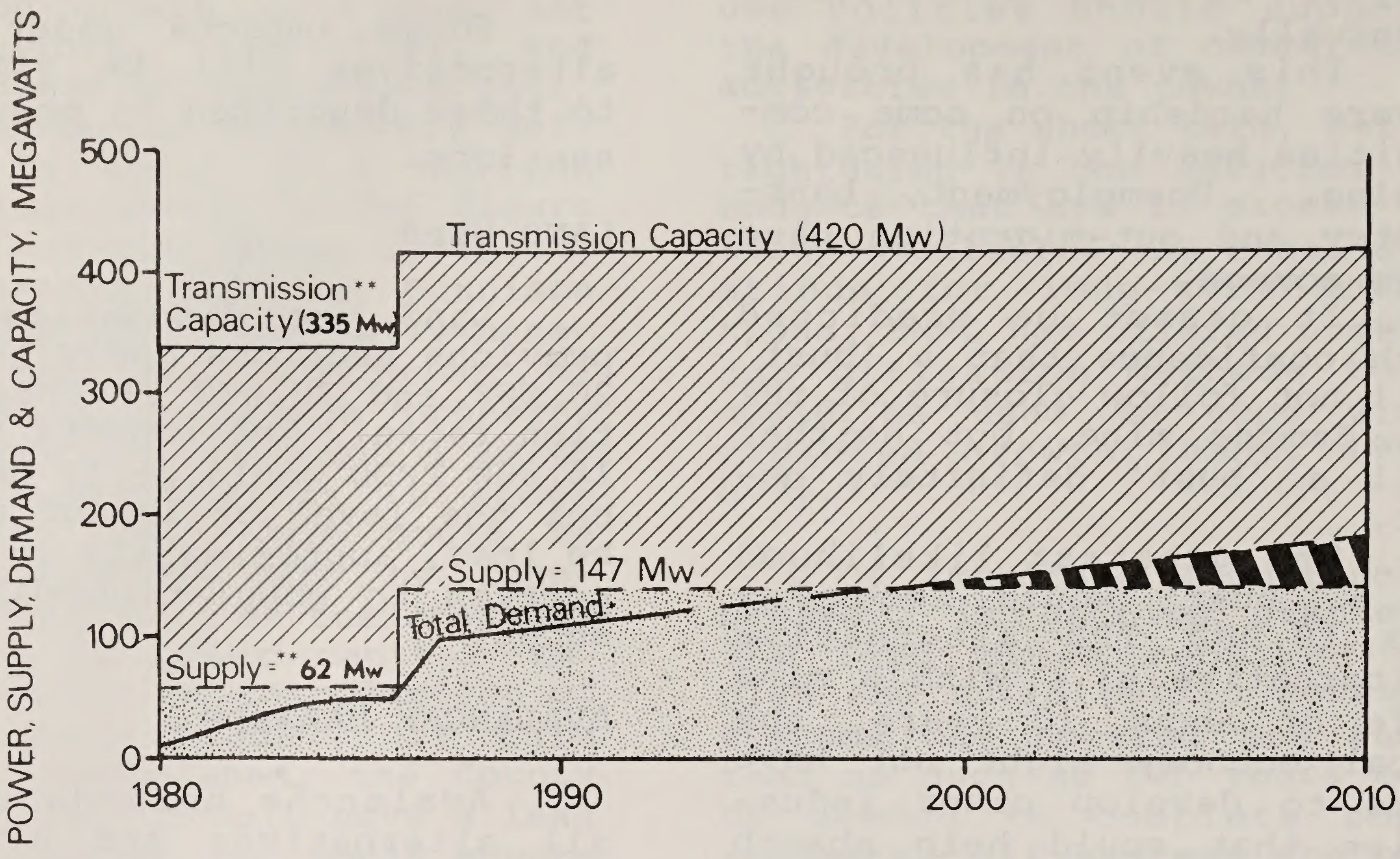
PAGE REFERENCE

Power Source 219
Voltage. 223
Overhead Lines 223
Combined Systems . . . 229
Location 232

This section analyzes the impacts of providing electrical power to the Project.

POWER SOURCE

Using data provided by Western Area Power Administration (Western) (DOE-WAPA, 1981), and a Power Requirements Study by GCEA (Gunnison County Electric Association, 1980), the Forest Service



* source: Gunnison County Electric Association, 1980. Power Requirements Study

** source: DoE correspondence, 7/10/81

LEGEND

- ░ Power assumed firmly available **
- ▨ Power presently under agreement to move to other locations **
- ▚ Power presently under agreement to move to other locations that may have to be made available to the Gunnison Area.

Mt. Emmons Mining Project

ESTIMATED ELECTRICAL DEMAND in the GUNNISON COUNTY ELECTRIC ASSN. SERVICE AREA COMPARED TO TRANSMISSION CAPACITY and AVAILABLE SUPPLIES

August 1981

FIG. 4-18

compiled an estimate of electrical power supply, demand and transmission capacity for the service area of Gunnison County Electric Association, (Figure 4-18).

From 1980 until 1986, the only power transmission facilities bringing electrical power into the GCEA service area are two lines owned by Western: a 115 kV line and a 230 kV line, both passing near Gunnison. The transmission capacity of these lines is adequate to supply GCEA's projected demands if there are no other users. However, the current power allocation on these lines under peak demand conditions only leaves a maximum of approximately 62 Mw available for the GCEA service area. This power level is inadequate to supply projected demands, including the Mt. Emmons Project, beyond 1986.

Figure 4-18 depicts a rise of 85 megawatts in both transmission capacity and supply in 1986. This change is a result of completing a west tap and transmission line to the Mt. Emmons mine site (Alternatives 2-4 and 7). Under the linear growth assumptions applied to demand in Figure 4-18, the power available (147 Mw) will be adequate to supply the demand to about the year 2000. In order to provide adequate power beyond 2000 and into the mine closure period, when power demand should drop appreciably, several steps could be taken:

(1) Due to increased emphasis on efficient energy use or errors in projecting long-range energy requirements, the supply could be adequate to cover the demand.

(2) Agreements for power delivery to other locations could be adjusted to make more of the power on Western's lines available for the Gunnison area.

(3) New transmission line projects could be initiated. Either Western's lines could be upgraded to 345 kV or a new transmission line into or through the area could be constructed.

(4) The currently proposed 115 kV transmission line could be constructed as a 230 kV transmission line (Alternatives 5 and 6).

Aside from the power supply situation under normal operating conditions discussed above, officials of Western Area Power Administration have confirmed that, under emergency conditions and for short time spans, it would be possible to supply the power from lines near Gunnison (Alternatives 2-7). Such conditions may cause high power losses and undesirable voltage drops.

Loop Systems
(Alternatives 2-7)

Engineering, Economic, and Technical Considerations - A loop system is the most practical means of providing reliable electrical power to facilities that need to operate full-time. When coupled with automatic switching, a highly reliable and flexible system can be installed, in which line failures create only momentary outages (IEEE, 1978).

Loop systems have servicing advantages because line sections can be isolated for repairs without customers losing service. However, additional power sources into the work area increase the risk for accidents during repair.

The loop system proposed by GCEA is approximately 70 miles long.

This system will put transmission lines through presently unserviced areas. This could avoid future impacts if unforeseen developments should arise in those areas. It is possible that the presence of electricity in an area could encourage future economic development.

Finally, the loop system proposed by GCEA involves tapping a primary power source which will be needed in the future even without the Mt. Emmons Project.

One Electrical Transmission Line with Onsite Generating Capacity

An Onsite Coal-Fired Plant

Engineering, Economic and Technical Considerations - Operating in a standby mode, a coal-fired power plant can be "turned down" to about 17-20 percent capacity without exceeding emission standards. Minimum coal and water consumption in this mode will be 92 tons and 0.5 acre-feet per day (or 33,580 tons and 186 acre-feet per year). The cost of standby operation will exceed $2,000,000 per year.

The power plant, when operating in the standby mode (boilers up to pressure, turbines pre-heated) will require 2 hours before the turbines can be partially loaded, and another 4-6 hours before it can be stabilized and producing at full capacity.

The capital cost of large, commercial power plants is estimated to be $1,000 to $1,100 per kw of capacity. A small plant such as this could cost as much as $2,000 to $2,200 per kw ($100 to $110 million).

An onsite coal-fired power plant operated in a standby mode will not be economically feasible, nor can it provide the instantaneous response required to protect worker safety and maintain environmental control systems. To use the plant effectively, it will have to be operated as the primary power source for the Project with the public utility line used as the backup system.

The plant will burn about 180,000 tons of coal annually. The plant will consume 1,035 acre-feet of water annually, and will require a reservoir of 2,000 acre-feet to provide adequate reserve for dry years. Lime for stack scrubbing will be trucked to the site.

Environmental Impacts - Whether operated in the standby mode or as the primary power source, a coal-fired power plant will significantly increase emissions of particulates, SO_2 and NO_x. Air quality impacts will depend on ultimate siting. Water vapor from the cooling towers will make the facility more visible. The Project's consumptive water use will increase by 30-50 percent.

In addition, noise and visual intrusion will occur. Potential for contamination of area streams will increase.

Socioeconomic Impacts - Minor socioeconomic impacts will result from the employment of 40 additional people.

An Onsite Diesel-Fired Power Plant

Engineering, Economic, and Technical Considerations - The capital cost of this facility will be in the $30-$40 million range. The cost of power production will be about $.074 per kwh for fuel, which is far in excess of the cost of commercial electrical power.

Response to a power failure can not be instantaneous because of the time required to get the engines started and stabilized and the generators up to full power. Therefore, this plant will have to be operated as the primary source of power with the public utility line as the backup system.

The logistics of transporting large quantities of diesel fuel will be unattractive, as will be the overall capital and operating costs of the plant.

Environmental Impacts - Impacts from a diesel-fired power plant will be similar to those from a coal-fired power plant. The potential for spills of diesel fuel will be increased.

Socioeconomic Impacts - Minor socioeconomic impacts would result from the employment of additional personnel for the plant.

VOLTAGE

The 115 kV line proposed by GCEA (Alternative 2) will provide minimum acceptable service for the Project, but additional capacity will eventually be needed to meet the demands of increasing population. On the other hand, a 230 KV line (Alternatives 5, 6) will meet both Project requirements and long-term population needs. A 230 kV system will experience half as much energy loss during transmission as will a 115 kV system, but its capital and operating costs will be about 38 percent higher.

Environmentally, a 230 kV line may cause less impact because it may be feasable to use non-reflective steel lattice towers, which create less visual impact; the towers would be higher, thus requiring less vegetation removal and tree topping. With lattice towers, spans can be longer and fewer towers required.

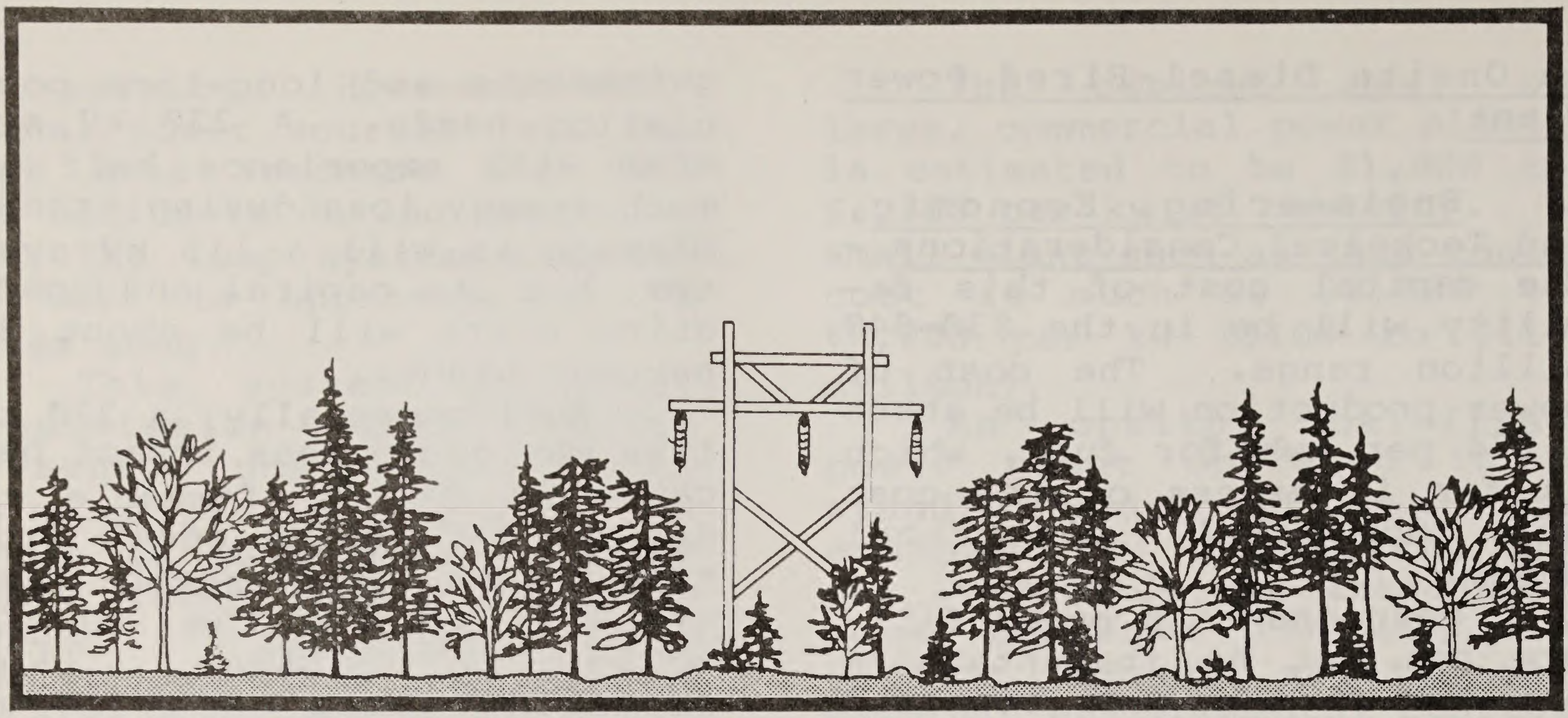
OVERHEAD TRANSMISSION LINES (Alternatives 2-5, 7)

This section discusses in detail the impacts resulting from installing and operating overhead transmission lines.

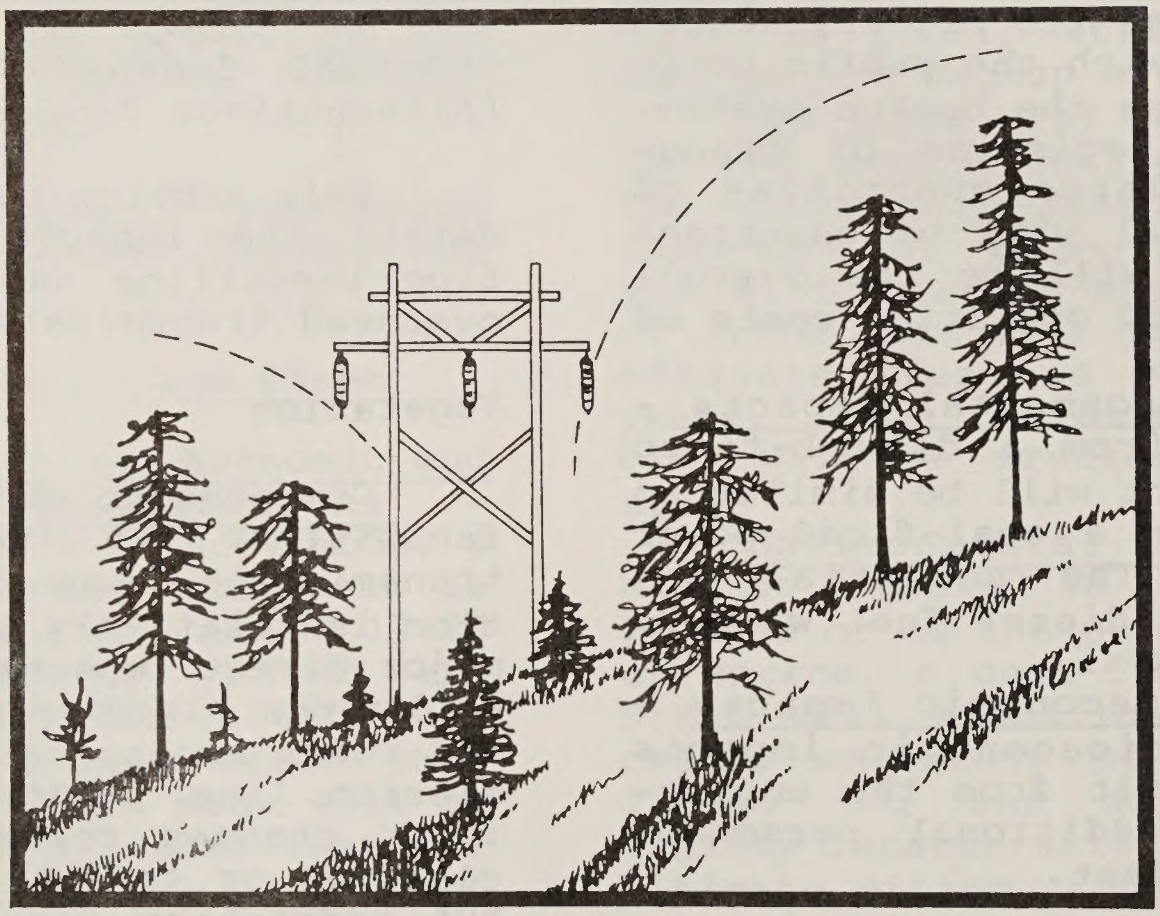
Vegetation

Compared to other Project facilities, the impact of a transmission line on vegetation is relatively small. The major direct impacts are caused by the placement of towers and roads accessing the transmission line. Forested areas incur changes related to the clearing or topping of trees, but understory vegetation often remains relatively intact (Figures 4-19 and 4-20). Only about 20 square feet of productive ground is ultimately lost to each tower installed. Access roads 10 to 14 feet wide will require between 1 and 2 acres of clearing per mile.

Toxic Emissions - Extra high voltage lines (345 kV and larger) can produce above-



a. Selective tree removal and topping reduces the visual impact of the right-of-way



b. Danger Trees

Trees that could damage the conductor - if they fell - should be marked as danger trees. All danger trees should be removed or topped. The health of a tree is a decisive factor in its designation as a danger tree.

Figure: 4-19

TYPICAL CLEARING FOR OVERHEAD TRANSMISSION LINES

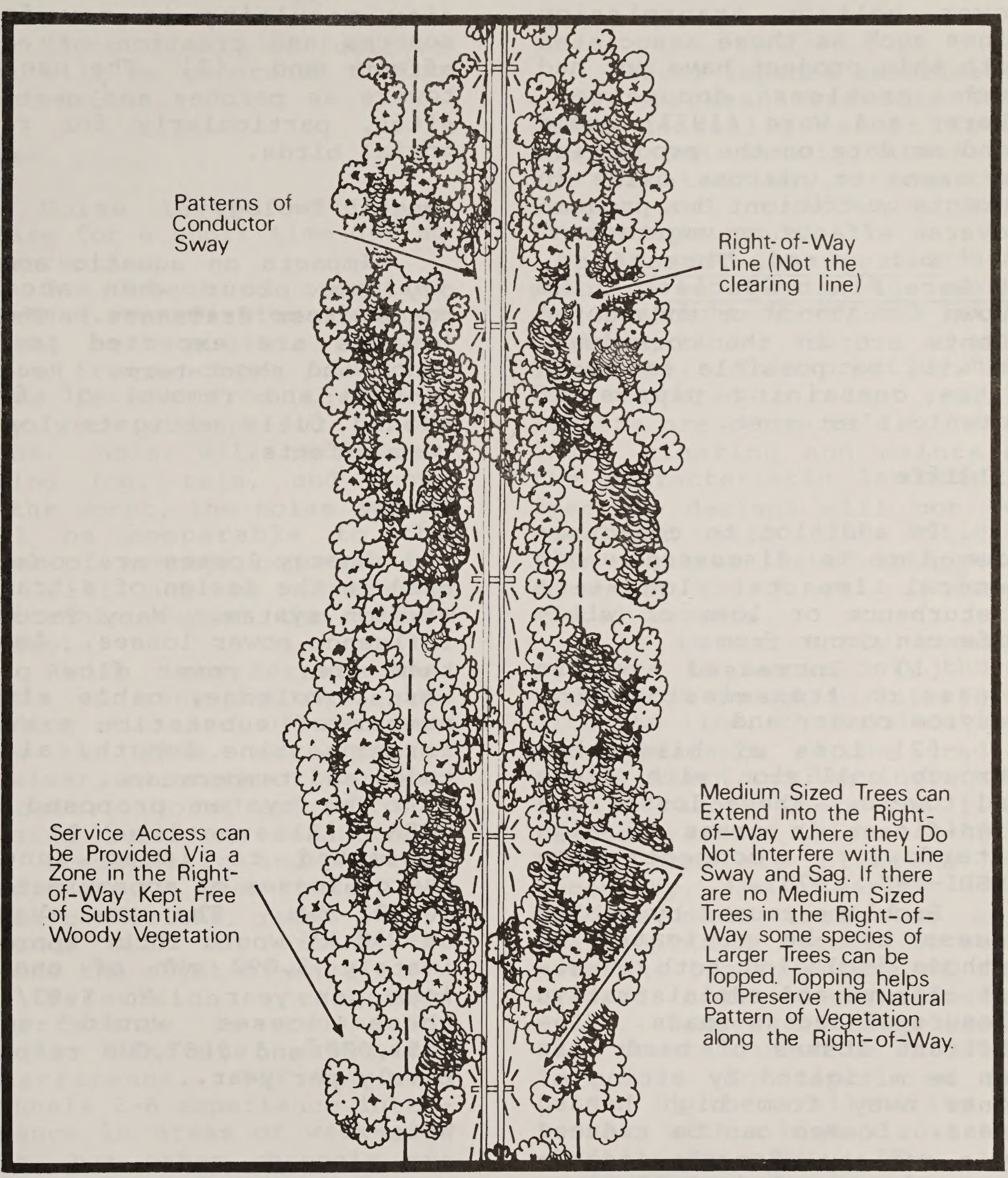

Patterns of Conductor Sway
Right-of-Way Line (Not the clearing line)
Service Access can be Provided Via a Zone in the Right-of-Way Kept Free of Substantial Woody Vegetation
Medium Sized Trees can Extend into the Right-of-Way where they Do Not Interfere with Line Sway and Sag. If there are no Medium Sized Trees in the Right-of-Way some species of Larger Trees can be Topped. Topping helps to Preserve the Natural Pattern of Vegetation along the Right-of-Way.

Figure: 4-20
VIEW OF RIGHT OF WAY PATTERN AND CONDUCTOR SWAY FACTOR

normal amounts of ozone and nitrous oxide, which can have adverse effects on vegetative vigor and growth (Hill, 1961). Lower voltage transmission lines such as those associated with this project have not had such problems documented. Sherer and Ware (1973) could find no data on the production of ozone or nitrous oxide in amounts sufficient to produce adverse effects on vegetation.

Endangered, Threatened, or Rare Plant Species - No known threatened or endangered plants are in the corridors. It will be possible to avoid sites containing plants of botanical interest.

Wildlife

In addition to construction impacts discussed under General Impacts, long-term disturbance or loss of wildlife can occur from:

(1) Increased public access on transmission line service roads; and

(2) Loss of bird life through collision with lines and towers. These losses are significant in areas of high waterfowl concentration (USDI-FWS, 1978).

Problems caused by public access can be mitigated by methods including both physical closure and administrative closure of access roads. Significant losses of bird life can be mitigated by siting of lines away from high hazard areas. Losses can be reduced by a variety of means including underground installation, tower design, changes in conductor height, increasing wire visibility, clustering lines at river crossings, installing shielding structures and modifying local habitat.

On the other hand, benefits can accrue to wildlife due to: (1) Changes in vegetation type, height and density resulting in new food sources and creation of edge effect; and (2) The use of towers as perches and nesting sites, particularly for raptorial birds.

Aquatic Ecology

Impacts on aquatic ecology can occur when access roads cross drainages. These impacts are expected to be minor and short-term. Revegetation and removal of fill should fully mitigate long-term effects.

Energy

Energy losses are considered in the design of a transmission system. Many factors influence power losses. Among them are: power flow patterns, voltage, cable size, number of substation transformers, line length, altitude, and temperature.

The system proposed by GCEA (Alternative 2) is estimated to incur annual energy losses of approximately 10,731 Mwh. The same system at 230 kV would incur approximately 5,090 mWh of energy loss per year. At $.03/kWh these losses would cost $351,000 and $167,000 respectively per year.

Water

Impacts on water quality will be minor in nearly all cases because extensive clearing and earthmoving are not expected. Minor sediment loadings may accompany the construction of access roads, but these will be reduced following revegetation.

Air

Minor amounts of fugitive dust will be generated during construction.

Noise

Noise levels will increase for a short time during construction.

One impact of operating overhead transmission lines is noise, both audible and at radio frequencies. Audible noise levels from the line vary with atmospheric conditions. Noise will be highest during fog, rain, and snow. At the worst, the noise levels will be comparable to the level of average conversation and will not be adversely noticeable beyond the right-of-way.

Radio interference depends on many factors, including distance of receiver from the line, strength of receiver, strength of incoming signals, amount of corona-causing burrs on conductors, and atmospheric and weather conditions. Even under adverse conditions, radio interference will not extend far beyond the right-of-way.

Television reception interference is caused by similar factors as radio interference. VHF low-band channels 2-6 experience interference in areas of weak signals, but other channels are seldom affected.

Cultural Resources

The general impacts of overhead powerlines are addressed on page 106.

Cultural resource impacts can be mitigated easily through tower placement.

Visual Resources

Visual impacts associated with overhead transmission lines generally result from topping and removing trees in the right-of-way, from the towers and conductors, and from access roads.

It used to be standard practice to clear a wide swath for the right-of-way and leave a strong linear feature on the landscape. This practice has been tempered in recent years. Efforts are being made to minimize clearing and maintain the characteristic landscape. Specific designs will not be developed until later. Mitigation measures listed in Appendices A and B will reduce visual impacts.

It is currently common practice to remove only those trees high enough to interfere with the line, thus moderating the appearance of the traditional swath and leaving a sag in the canopy where the line passes overhead (Figure 4-19). Where complete clearing is necessary, the clearing edge can be made irregular and small openings created to help mute the linear nature of the cleared right-of-way (Figure 4-20). Removal of large trees near towers cannot be avoided.

Line location can be guided by the availability of terrain with a high Visual Absorption Capacity. The impacts of towers and conductors can be minimized through screening and using structures and colors designed to blend with the surrounding terrain (Forest Service, 1975).

Access roads will have impacts similar to those described under Worker Access System for the various alternative mine and mill sites. However, in the case of transmission lines there will be opportunities through tower siting to place roads in areas with the best opportunity to absorb visual impacts and thus minimize contrasts. In terrain of high visual sensitivity, techniques that avoid roads altogether can be employed. Helicopter construction is one such technique.

During construction of the transmission system, visual contrasts will be at their greatest because of the unnatural appearance of freshly-disturbed surfaces and because of the miscellaneous supplies, equipment, camps and staging areas present in the construction area.

An estimated 10 percent of the inventoried VQO's in the Kebler Pass - Horseranch Park area will not be met. Road and trail crossings will offer the greatest difficulty. However, should a line be built through this area, it may be possible to reduce this impact through site-specific design.

Outdoor Recreation

The presence of overhead lines will not ordinarily conflict with recreation except in those cases when a recreationist encounters a line in an otherwise undeveloped area. This can be partially mitigated with an information program that explains the location of Project facilities.

Fire

Overhead transmission lines increase fire risk. However, since high dollar values are placed on dependable electrical transmission, regular maintenance will mitigate many potential fires. Nevertheless, natural phenomena such as lightning or land slides can cause transmission line failures that subsequently start fires.

Geology

Geologic resources will not be noticeably affected; geologic hazards will generally be avoided.

Soils

Soils will be disturbed where roads and tower pads are placed, but by using the standard stabilization practices it should be possible to avoid prolonged erosion.

Land Uses

On Federal lands, either easements or special-use permits will be required for rights-of-way for 115 kV or 230 kV lines.

Avalanche Hazard

Most alternative corridors are not in areas of avalanche hazard. For those that are , final line location will likely avoid or span hazardous areas, or include design measures to assure stability during avalanches.

COMBINATIONS OF SYSTEMS (Alternative 6)

This section discusses potential impacts from burying a portion of the system through the visually sensitive area from Kebler Pass to Horseranch Park.

Engineering, Economic, and Technical Considerations - Selected routes for pipe-type oil cooled cables must avoid rapid changes in elevation, sharp bends, and rocky terrain (Miller, 1976). This constraint could lead to a tunnel effect from right-of-way clearing. If existing roads are chosen for burying a transmission line, the pipeline may have to cut across many of the sharper curves.

As the cost of an underground system ranges 6-20 times that of an overhead system of equivalent capacity, economic considerations usually dictate the shortest, straightest route (Miller, 1976).

Although underground systems have operated for more than 20 years without interruption, there is a possibility of failure. Underground cables are immune to the hazards of weather-related events that damage overhead lines, but they are still subject to accidental damage from: digging operations, geologic changes such as erosion and earthquakes, corrosion at voids in protective coating, and internal defects. When the pipe is ruptured, insulating oil leaks out. The quantities of oil spilled depend on the design of the system, the location and size of the rupture, and the time required to detect and stop the leak. Typical reported leakage rates per incident for these systems range from less than 200 to more than 1,400 gallons per hour (EPRI, 1975).

While most overhead transmission line outages can be repaired in hours, underground cable outages require excavation of the cable, and repairs may involve weeks or even months (Miller, 1976). Cable repairs are expensive, and transmission capability is lost for extended periods.

Underground transmission systems are less subject to damage by vandalism and weather phenomena.

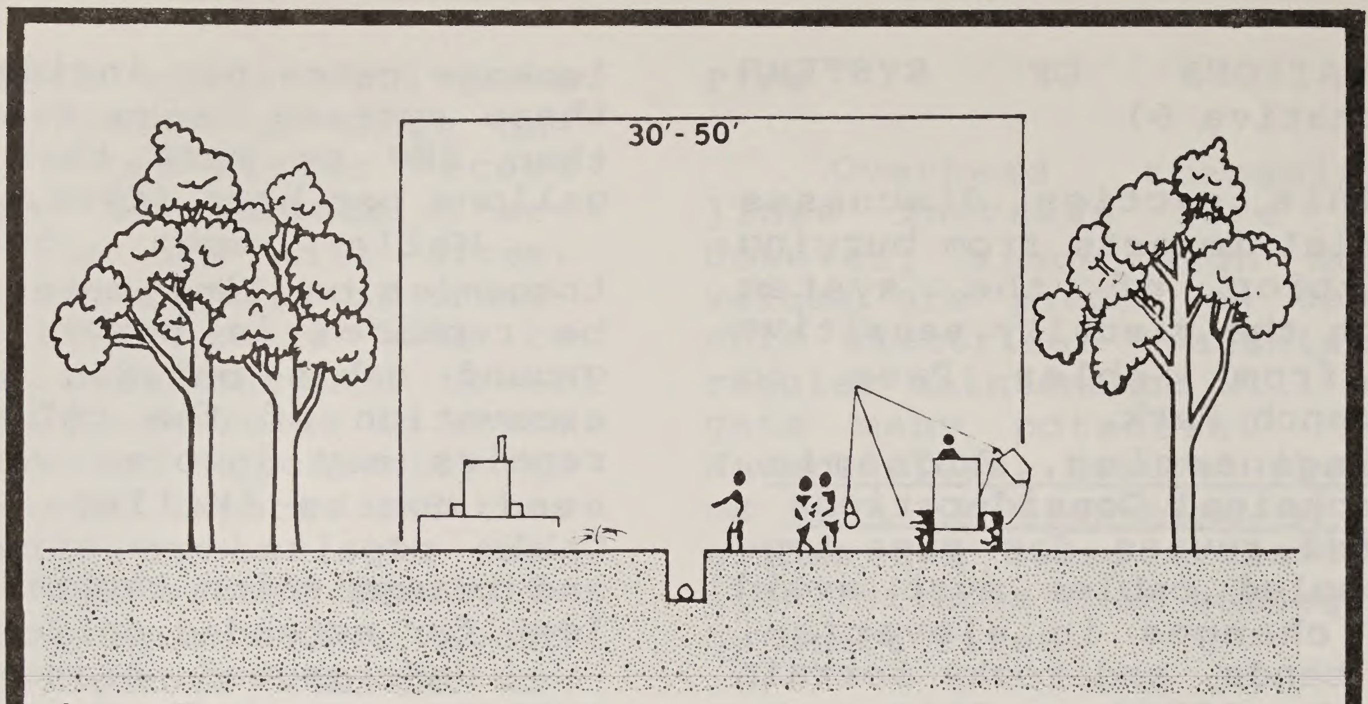
Vegetation

As shown in Figure 4-21, the clearing requirements for underground transmission lines impact vegetation more than do the requirements for overhead lines. Where underground transmission lines must pass through native vegetation, the excavation and replacement of trenching soil, as well as the equipment work areas, create short-term bare ground conditions on 3-6 acres per mile. This impact can be mitigated long-term through reclamation.

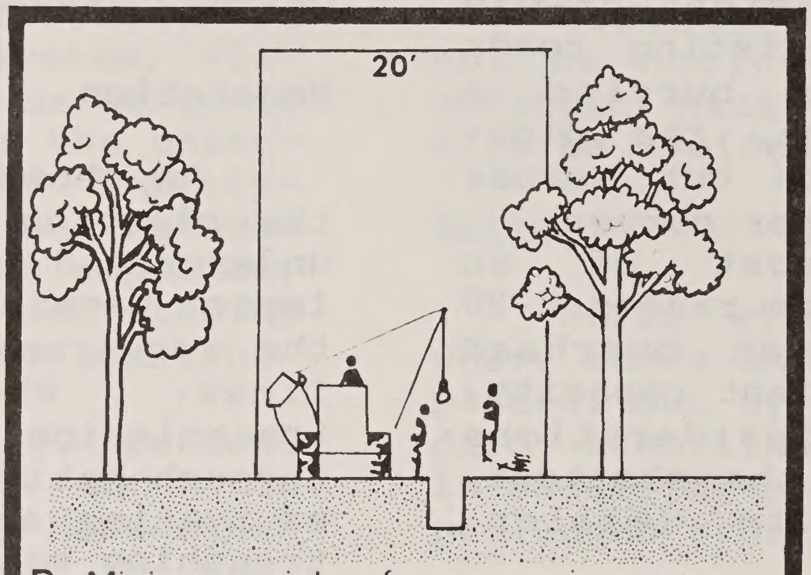
Long-term vegetative changes can occur as a result of ground heating and drying. Heat disperson creates a thermal gradient from the cables which have normal temperatures of 131°-167°F (EPRI, 1975).

Wildlife

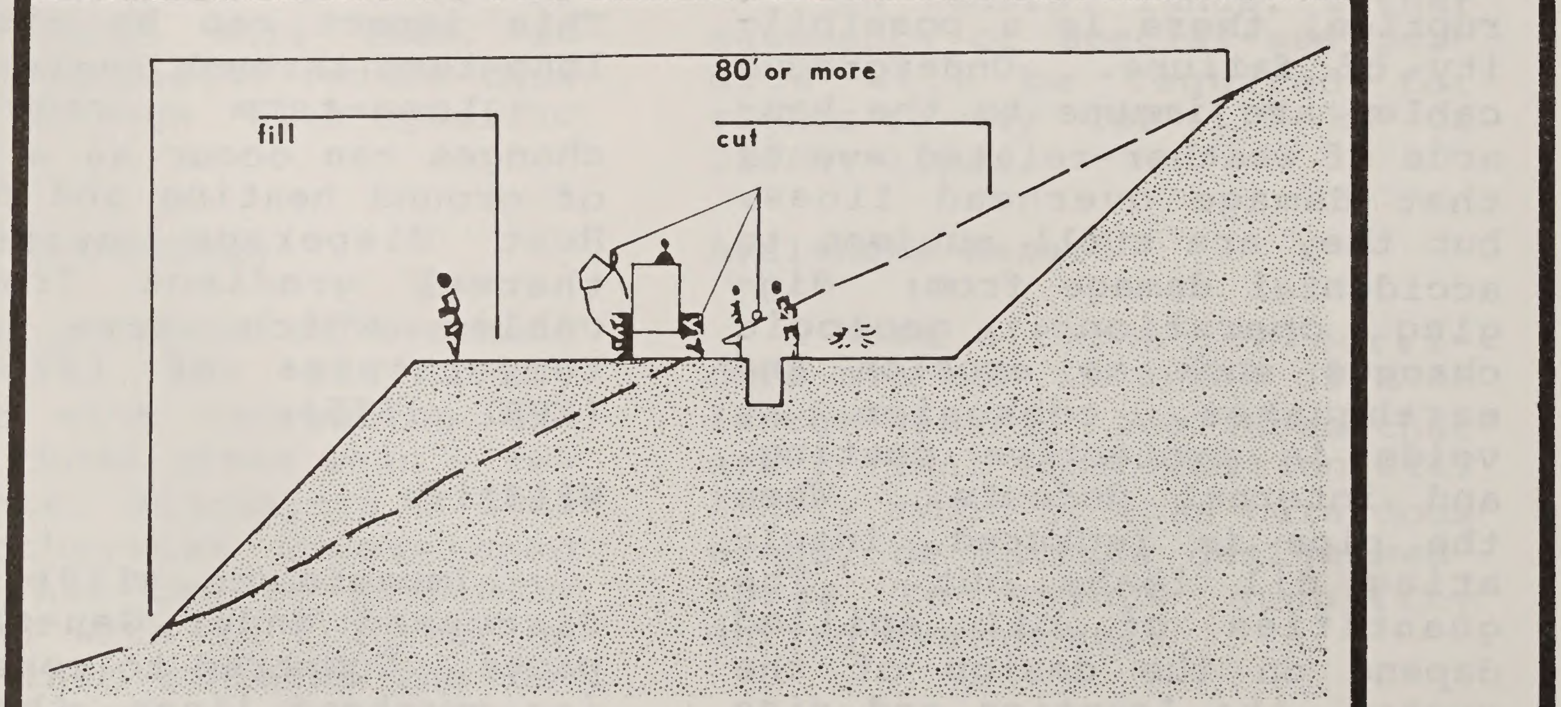
Impacts on wildlife are discussed under General Impacts. Compared to constructing overhead lines, the wildlife changes caused by constructing an underground line are considerably greater,



A. Typical right-of-way requirements for off-road installations



B. Minimum right-of-way requirements
(for short distances only)



C. Right-of-way requirements during construction on steep slopes.

Figure: 4-21

Source: EPRI (1975)

TYPICAL CLEARING FOR UNDERGROUND TRANSMISSION LINES except where underground lines can be installed in road rights-of-way.

Aquatic Ecology

Disturbances caused by burying transmission lines in streambeds have the potential to accelerate normal rates of change in the aquatic environment. Most significant among these changes will be substrate movement and changes in stream channel geometry. While these changes can result in direct fish mortality, they are not expected to have long-term effects.

Blasting at crossings may kill fish and other stream organisms. This effect is not expected to reduce long-term fish populations.

Energy

Overhead lines can carry 2.5 to 3 times as much power as the same size conductor buried underground. The difference results from the ability of the overhead conductor to dissipate the heat generated faster than the underground conductor (Gilman and Steve, 1971).

Water

During construction of the underground transmission facility, some suspended sediment loadings are expected. These can be minimized using mitigation measures. Greater sediment loadings are likely than from an overhead line because of the greater amount of clearing and earthmoving required. Following revegetation, sediment loadings should be minimal.

Air

A minor amount of fugitive dust will be generated during construction. It is likely to be greater than that generated by an overhead line because of the greater amount of earthmoving required.

Noise

Temporary noise will be generated during construction by heavy equipment.

Visual Resources

Where an underground transmission facility cannot follow an existing road, it will be necessary to clear a swath and, on sloping ground, create a flat surface using cut and fill construction techniques (Figure 4-21). During construction in terrain of low Visual Absorption Capacity, this will lead to sharp contrasts in form, line, color, and texture. It will not be possible to meet inventoried VQO's along much of the corridor. Once vegetation has been reestablished on the disturbed areas, contrasts in color and texture will be greatly reduced but the form and line contrasts will persist because of the clearing and ground levelling. At this stage the underground transmission facility may offer fewer contrasts overall than would an overhead line. Terminals will still be necessary at the points where the lines pass underground. Depending on the sites chosen for the terminals and the screening capabilities of the areas surrounding them, it should be possible to keep them out of sight.

Following reclamation, the original character of the landscape should return if the levelled areas are restored to the original contour. If not, some contrast in form and line may persist until trees grow up in the right-of-way. In either case it should be possible to meet inventoried VQO's.

Outdoor Recreation

Impacts will be similar to those discussed for overhead lines.

Geology

Impacts will be similar to those discussed for overhead lines. Some steeper slopes underlain by mass movement deposits may be prone to slumping if they are crossed.

Soils

Greater soil disturbance is expected than with overhead lines, but overall the impacts will be minor.

Avalanche Hazard

Impacts will be similar to those discussed for overhead lines.

SYSTEM LOCATION

The study sequence described in Appendix D and in CDM (1980e-n, 1981c) involved successive approximations that avoided areas where the most severe impacts would likely occur. For example, all alpine and (where possible) subalpine environments were avoided during corridor identification. Thus, the impacts of putting a powerline in the corridors will be less by design than putting them elsewhere.

"Technical factors provide enough flexibility to enable virtually all environmental objectives to be met in the design and location of a utility line. However, the cost is sometimes high and, indeed, may be prohibitive. In adjusting the location of a corridor or right-of-way because of environmental consideration, the most obvious effect will be an increased cost in constructing and/or maintaining the line, with attendant higher prices that must be paid by the utility's various consumers.

"Sometimes, the cost may have an indirect effect, in terms of reduced system performance. For example, in an electric transmission line, power losses are a function of distance. Thus, if the length of the line must be increased, a greater amount of power will be lost (principally from resistance in the line). In order to deliver a specified amount of power for consumption, the amount generated must be increased; and the percentage of increase necessary is as great as, or slightly greater than, the percentage of line loss. In addition to increased dollar costs for generating additional power, there will be indirect environmental effects resulting from such requirements as mining and consuming additional amounts of fuel and resources used in contructing the line. In many instances, the practical environmental impacts of increased length may be negligible; however, they should not be overlooked in a comprehensive evaluation of alternative line locations, because the potential for impact increases with an increase in length of the line." (BLM, 1975)

Comparing the impacts of alternative corridors is complex. Not only are final line locations unknown, but many resources are affected. "Probability of impact" thus becomes an important concept; it is used in place of predictable real impacts. For the Mt. Emmons Project, the concept was employed using 'suitability indices'. These represent the environmental and engineering factors considered most important for comparing alternative corridors. Eighteen factors representing seven disciplines were used. These are listed in Table 4-51.

For each corridor segment shown in Figure D-2 on page 352, a suitability index was developed for each of the eighteen factors, as described in CDM (1980f). Index values range from a low suitability of 100 to a high suitability of 300. The results are in Table 4-52.

The segments must be combined and averaged to reflect the corridors in Alternatives 2-7. The results are in Table 2-4 on page 35.

In addition to the suitability index, other items pertinent to corridor comparisons

TABLE 4-51 ENVIRONMENTAL AND ENGINEERING FACTORS USED FOR SUITABILITY INDEX DETERMINATION

Vegetation

- Visual Sensitivity
- Regeneration Potential
- Range Productivity
- Species Richness

Geologic Hazards

- Geologic Hazards

Engineering

- Clearing Difficulty
- Construction Access
- Terrain Complexity
- Slope Range

Soils

- Regeneration Potential
- Erosion Hazard
- Roads
- Staging Areas
- Towers

Wildlife

- Small and Non-Game Species
- Big Game

Archaeology

- Site Density
- Site Susceptibility

TABLE 4-52. ALTERNATIVE TRANSMISSION LINE CORRIDOR SEGMENT SUITABILITY INDICES

		Vegetation			Wildlife		Archaeology	
Segment	Visual Sensitivity	Regen. Potential	Range Prod.	Species Richness	Small and Non-Game	Big Game	Site Density	Site Susceptibility
A	183.2	188.4	188.9	121.0	142.6	278.7	287	300
B	203.3	226.0	161.9	183.7	125.6	282.5	291	300
C	182.4	217.4	152.9	155.9	121.6	160.8	296	300
D	196.1	222.7	159.9	154.8	135.0	265.5	295	300
E	194.4	198.4	151.9	123.3	116.6	173.5	298	300
F	178.7	222.4	206.8	203.2	181.0	198.4	290	300
G	199.6	255.9	165.7	126.4	134.8	207.5	289	300
H	188.5	269.7	242.2	266.9	184.9	277.1	284	200
I	190.6	163.6	236.9	142.1	181.4	191.6	294	300
J	169.2	171.6	224.9	144.5	163.4	276.6	292	300
K	197.6	220.7	202.1	141.0	151.5	135.7	284	300
L	193.8	245.4	162.9	176.7	165.8	250.3	284	200
M	183.9	252.7	166.4	195.6	184.3	226.4	295	200
N	198.9	258.4	177.5	217.7	198.0	243.3	300	300
O	215.3	237.7	171.1	195.4	182.8	141.2	252	200
P	200.0	254.5	177.3	202.6	183.3	285.3	298	200
Q	201.6	258.0	174.1	215.2	197.2	174.7	298	200
R	196.1	263.3	162.3	238.9	236.1	110.6	288	200
S	198.1	261.0	165.3	233.6	215.4	109.0	280	200
T	225.8	223.1	173.0	246.3	226.5	238.4	282	200
U	253.3	258.6	176.1	222.7	288.0	262.3	115	100
V	267.0	254.1	178.2	219.6	190.6	226.8	197	300
W	120.8	247.9	159.6	187.0	199.6	249.9	274	200
X	189.0	183.9	204.1	135.7	158.3	109.3	286	200
Y	150.3	203.8	186.5	143.6	162.9	300.0	287	200
Z	267.3	251.5	174.5	202.6	186.5	255.4	100	200
AA	271.9	258.9	180.3	218.8	200.0	200.0	141	100
AB	213.3	260.2	171.8	229.0	206.2	300.0	188	100
AC	197.9	261.6	173.6	227.2	206.5	143.7	**	100
AD	195.3	255.8	170.2	224.4	173.9	150.6	**	**
AE	178.2	185.3	176.3	202.7	160.7	300.0	**	**
AF	193.3	219.0	170.8	170.1	145.6	194.7	**	**
AG	161.4	222.2	170.9	194.9	181.9	300.0	**	**

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* Corridor segments can be located on Figure D-2

** Values assumed equivalent to adjacent corridor segments

TABLE 4-52. (continued)

	Soils					Geologic Hazards	Engineering				
			Limitations for								
Segment	Regen. Potential	Erosion Hazard	Road	Staging Area	Tower		Clearing Difficulty	Constr Access	Terrain Complex.	Slope Range	Segment Midline Length (mi)
A	229.0	248.5	175.0	200.2	174.8	196.5	122.4	182.6	213.0	191.3	12.6
B	282.4	203.1	148.7	197.8	150.9	185.4	173.0	243.7	246.8	250.0	9.8
C	267.4	217.6	143.9	191.2	152.7	193.0	160.3	193.7	179.4	179.3	10.3
D	276.9	212.3	150.9	194.1	156.8	207.0	162.1	217.7	211.7	209.8	12.8
E	236.4	231.8	134.1	184.1	150.0	187.7	113.4	197.6	212.2	222.0	7.2
F	166.8	159.2	152.7	195.1	168.4	214.0	190.3	199.9	211.2	200.0	10.0
G	263.3	197.0	146.7	191.3	139.6	213.4	153.9	203.9	253.8	200.1	11.3
H	130.6	143.2	136.2	194.6	195.4	275.4	235.9	254.4	190.0	280.0	9.4
I	150.4	225.1	177.7	207.7	187.5	254.2	124.1	128.5	221.4	175.0	3.9
J	139.6	265.9	170.5	193.4	186.0	212.1	137.6	150.0	229.3	164.7	5.1
K	245.3	235.3	167.3	200.8	167.8	216.3	189.9	192.6	248.1	218.5	7.9
L	233.6	210.2	164.5	210.2	175.7	240.1	221.4	230.6	250.0	236.1	7.5
M	265.0	216.8	173.0	216.3	180.3	219.4	252.3	226.2	183.3	205.5	9.2
N	282.3	208.7	148.0	196.8	158.3	236.4	289.5	211.0	205.6	211.2	4.1
O	179.3	242.9	176.2	226.4	207.9	265.1	240.8	212.1	275.9	229.7	15.1
P	232.0	242.0	160.8	195.4	165.9	226.2	267.0	188.2	233.3	258.9	4.7
Q	220.5	230.6	171.2	202.1	198.7	210.6	284.7	188.8	211.2	194.4	4.6
R	201.0	248.0	194.4	249.1	240.2	260.3	290.1	288.9	122.2	255.5	9.7
S	162.8	269.6	210.3	245.6	230.7	248.2	277.7	260.0	160.0	260.0	3.4
T	173.5	226.3	181.0	196.2	189.3	282.7	251.6	240.0	220.0	240.0	5.4
U	172.8	195.3	184.5	214.2	208.8	267.3	298.8	241.7	237.5	245.8	7.2
V	171.5	203.0	198.1	205.7	214.6	202.6	277.1	226.9	246.1	203.9	5.1
W	133.0	278.2	267.0	291.6	269.8	249.2	230.4	300.0	100.0	300.0	2.6
X	162.4	261.3	199.6	230.0	204.4	203.7	151.5	157.2	157.2	157.1	4.3
Y	149.7	250.1	227.3	255.9	225.7	233.6	151.6	191.7	200.0	100.0	2.0
Z	204.1	204.0	193.5	228.6	238.1	242.9	268.2	227.8	221.1	238.9	8.2
AA	165.7	203.3	200.0	218.2	215.7	273.9	295.7	187.5	237.5	250.0	1.9
AB	185.7	214.9	184.0	228.5	221.1	257.0	288.2	242.0	168.4	215.8	4.6
AC	209.1	225.2	186.5	273.4	238.2	266.4	297.9	191.6	197.6	202.4	22.5
AD	258.1	229.5	159.2	208.8	177.6	264.6	253.3	246.7	293.3	290.0	8.8
AE	146.8	276.0	172.5	191.2	185.6	213.7	117.4	171.6	186.9	178.3	6.4
AF	204.7	207.4	157.5	200.4	172.8	210.1	135.4	210.0	235.4	241.5	36.2
AG	151.9	248.0	228.8	260.1	226.5	227.2	120.0	270.0	250.0	220.0	2.7

have been analyzed. These are discussed below.

Common Corridor Miles - Section 5-3 of FLPMA requires that "the utilization of rights-of-way in common shall be required to the extent practical". The desirability of joint use in utility corridors is further emphasized in (USDA-USDI, 1971), "Environmental Criteria for Electric Transmission Systems". Table 2-3 on page 35 lists the approximate miles of corridor shared by power supply configurations and either other Mt. Emmons Project facilities or existing transmission facilities. Alternative 3 has the most common corridor miles (27) and Alternative 7 the least (12). One important element in sharing corridors involves using the access roads associated with the ore haulage system to the maximum extent possible for accessing transmission line construction sites.

Local-System Compatibility - It has been pointed out the GCEA has long-range plans that require additional service for its Skito substation west of Gunnison. Alternatives 2-6 satisfy this requirement while Alternatives 1 and 7 do not.

Land Uses - Short segments of the alternative powerline corridors extend into Delta County near Paonia. Included in corridor segment (H) are approximately 1,600 acres of farmland that are considered prime when irrigated. The impact of a carefully located and mitigated transmission line is not expected to significantly impact these farmlands.

Major Highway Crossings - Alternatives 2-6 include one crossing of U.S. 50 with a double-circuit 230 kV transmission line. While Alternative 7 appears to require only a single circuit 115 kV crossing of U.S. 50, it is likely that a double circuit 230 kV system will be proposed later to service the Skito substation. It, too, will also have to cross U.S. 50. Alternative 7 will also require a 115 KV line over Colorado 135, while Alternatives 2-6 will not involve any additional major highway crossings. Highway crossings can be substantially mitigated by employing design concepts in USDA-USDI (1971) and Forest Service (1975).

LAND EXCHANGE

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PAGE REFERENCE

General Selected Land Impacts 237
Coal Creek Mine Site. . . 237
Slate River Mine Site . . 238
Alkali Creek Mill Site. . 238
Carbon Creek Mill Site. . 239
Chance Gulch Mill Site. . 239
General Offered Land Impacts 239

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GENERAL SELECTED LAND IMPACTS

The development of the Mt. Emmons Project will not be determined by whether or not the land exchange is approved. If lands are exchanged, Forest Service administration and approval activities (including possible future NEPA analyses) will not be required after title is transferred. This could significantly reduce manpower and budget requirements over the Project life. This savings will be further amplified because several existing special use permits could be terminated. The exact number and nature of permits affected depends on the specific lands finally exchanged.

The land exchange will not be completed until satisfactory agreements are reached between AMAX and other affected parties with leases and permitted uses.

Prior to exchange, or if lands are not exchanged, Project construction on NFS lands could proceed under the authority of either the Forest Service's mining regulations in 36 CFR 228 (formally 36 CFR 252), or special use permits issued under the Organic Act of June 2, 1897, the Term Permit Act of March 4, 1915 (38 Stat, 1101) and FLPMA. If the Coal Creek mine site and either Carbon Creek or Alkali Creek mill sites were used, the Forest Service would be required to make time-consuming reviews and then administer Project activites affecting surface resources on NFS lands. These reviews could include further NEPA analyses.

Lands transferred to private ownership will reduce Federal payments to Gunnison County under two programs: payments in lieu of taxes (PILT), and the 25 percent National Forest receipts payments. In compensation however, Gunnison County would experience an increase in private property tax base and an increase in tax revenues.

COAL CREEK MINE SITE

AMAX has proposed a land exchange to obtain title to the Coal Creek mine site and the subsidence area on Mt. Emmons (Figure F-3 on page 372). AMAX has spent an estimated $2,500,000 to acquire private lands throughout Colorado which it is offering to the Forest Service in exchange for the NFS lands it wishes to acquire on Mt. Emmons.

Additional environmental analysis may be needed at a later date. Known effects of disposing of the mine site lands as proposed are described briefly below:

(1) 104 AUM's grazing capacity will be lost in the Coal Creek Cattle Allotment.

(2) 5,550 MBF of standing timber volume will be transferred to private ownership.

(3) The Mt. Emmons Iron Bog will be transferred to private ownership.

(4) Approximately 2.1 miles of Coal Creek and its associated wetlands and floodplains will be owned by AMAX.

(5) 5 miles of interior boundary will be added.

(6) 38 interior property corners will be eliminated.

(7) Certain areas being studied by Rocky Mountain Biological Laboratory will be transferred from public to private ownership.

SLATE RIVER MINE SITE

It is assumed that, even if the mine site were located on the Slate River, AMAX would pursue the land exchange proposal. The costs and some of the impacts of disposing of the mine site selected lands are discussed in the preceeding section.

In addition, AMAX would have to acquire private land for constructing the Slate River mine site. This purchase could add approximately 10 percent to mine site acquisition costs.

ALKALI CREEK MILL SITE

Mill-Tailing Area - AMAX has proposed a land exchange to obtain title to the Alkali Creek mill and tailing area (Figure F-4 on page 373). AMAX has spent an estimated $4,190,000 to acquire private lands throughout Colorado which it is offering to the Forest Service in exchange for the NFS lands it wishes to acquire.

Additional environmental analysis may be needed at a later date. Known effects of disposing of the mill site land as proposed are described below:

(1) 730 AUM's of grazing capacity will be lost in the Gothic Cattle Allotment.

(2) 1,084 MBF of standing timber volume, mainly aspen, will be transferred to private ownership.

(3) Approximately 2 miles of Alkali Creek and its associated wetlands and floodplains will be owned by AMAX.

(4) 6 miles of interior boundary will be eliminated.

(5) 13 interior property corners will be eliminated.

(6) The aspen 'fingers' used as cover by migrating elk will be transferred from public to private ownership.

Other Tracts - Two other land tracts AMAX proposes to acquire by land exchange are located along the Carbon Creek haulage corridor (Figure 2-2 on page 15). The Carbon Creek tract is to be used for construction of the Mt. Axtell tunnel and as the site for a potable water reservoir. The Red Mountain tract is to be used for construction of the Red Mountain tunnel. AMAX has spent an estimated $240,000 to acquire private lands throughout Colorado which it is offering to the Forest Service in exchange for these two tracts.

Some of the effects of disposing of these two tracts are listed briefly below:

(1) 15 AUM's of grazing capacity will be lost in the Castleton Cattle Allotment.

(2) 26 AUM's of grazing capacity will be lost in the Carbon Cattle Allotment.

(3) 408 MBF of standing timber volume (mostly aspen) will be transferred to private ownership.

(4) Approximately 1 mile of Carbon Creek and its associated wetlands and floodplains will be owned by AMAX.

(5) 3 miles of interior boundary will be added.

(6) 10 interior property corners will be added.

CARBON CREEK MILL SITE

No land exchange offer has been submitted for the Carbon Creek mill site. It is likely that, if this site were to be used, an exchange offer would be submitted. The offer will be evaluated when received by the Forest Service.

CHANCE GULCH MILL SITE

No land exchange offer has been submitted for the Chance Gulch mill site. It is likely that, if this site were to be used, an exchange offer would be submitted. The offer will be evaluated when received by the BLM.

GENERAL OFFERED LAND IMPACTS

Land Uses - If the Forest Service acquires the offered lands, development of these lands for homes and non-conforming commercial uses would be prohibited. Also, the probability of unauthorized occupancy on adjacent NFS land would be greatly reduced.

Wetlands - Acquiring the lands offered by AMAX will place approximately 331 acres of wetlands into the National Forest System. (AMAX 1981a and Glover et. al., 1981).

County Taxes - Lands transferred to Federal ownership will reduce the affected counties' tax bases, but will be added to the land base that contributes to Federal payments to counties through PILT and the 25 percent National Forest receipts programs.

LAND CLASSIFICATION

PAGE REFERENCE

Resource Characteristics .240
Advantages to the U.S. . .246
Disadvantages to the U.S..247

RESOURCE CHARACTERISTICS

PAGE REFERENCE

Gunnison N.F. 240
Arapaho-Roosevelt N.F.. .243
San Juan N.F. 245
White River N.F.. 245

Land classification is an administrative action which causes no environmental impacts. However, considerations are given to the advantages and disadvantages of future land ownership adjustments because classification decisions describe a desired ownership pattern which, to achieve, can have potential environmental impacts. This section describes the lands involved as well as the advantages and disadvantages of changing the desired ownership pattern. Land classification alternatives and procedures are discussed in Appendix E.

RESOURCE CHARACTERISTICS

Gunnison National Forest

Townships 13 and 14 South, Ranges 86 and 87 West, 6th P.M. - Coal Creek and Carbon Creek areas

The primary resource uses of these areas, which are proposed for disposal, are mining, domestic watershed, dispersed recreation and grazing (see Appendix E, Figures E-2 and E-7). Big game hunting is an important activity in the Coal Creek, Kebler Pass, Ohio Pass and Splains Gulch areas.

The volume of timber on the disposal area is about 5,550 MBF on about 1,340 acres. Most of this volume is in spruce-fir sawtimber, and occurs on unregulated commercial forest land. No significant change in NFS timber yields would result.

The estimated range carrying capacity on the disposal area is 145 AUM's; 104 on Coal Creek C&H allotment and 41 on the Carbon C&H allotment area.

Mineral prospecting and filing of mining claims covers nearly the entire Mt. Emmons - Coal Creek area. There are no known mineral filings in Carbon Creek. Additionally, there are existing oil and gas leases in Coal Creek and in the Oh-Be-Joyful drainages.

Dispersed recreation uses on the disposal areas include hiking, picnicking, hunting, fishing, climbing, sightseeing, and auto and ski touring. Annual visitor days use on the disposal area is estimated at 4,500 for the Coal Creek portion; 100 for Oh-Be-Joyful portion, and 50 in the Carbon Creek portion.

Special use permits in the Coal Creek area consist of 2 road rights-of-way, 3 utility lines, 3 research, and 1 each of air monitoring, water diversion, telephone line, and 14 kV electric transmission line. A cooperative agreement between the Town of Crested Butte and the Forest Service for municipal watershed operation and maintenance was entered into in 1979. If landownership adjustments occur in the disposal areas, the uses will be protected by the proponent executing satisfactory documents to ensure continued use.

The Town of Crested Butte has documented use of water sources in Coal Creek since the early 1900's. The Town's water intake and about 1,200 feet of transmission line are located on the proposed disposal area in Section 5, Township 14 south, Range 86 west.

Transportation facilities include the Kebler Pass Road, which is a county maintained road; the Keystone Mine Road, under special use permit to AMAX, Inc.; a segment of the Standard Mine Road, under permit to Standard Metals Corporation, a trailhead for Green Lake and Wildcat Gulch trails, and the Gunsight Pass four-wheel drive road.

There is no key or critical big game winter range within the Coal Creek - Oh-Be-Joyful portions of the disposal areas. The Carbon Creek area contains a small amount of big game winter range on the south slopes.

Wetlands are present in the Iron Bog on Mt. Emmons and in the riparian zones of both Coal Creek and Carbon Creek. There are no areas of Coal Creek or Carbon Creek classified as floodplains.

There are no known archaeological or historical sites in the disposal area boundaries. The Town of Crested Butte is a National Historic District.

Township 15 south, Range 86 West, 6th P.M. - Alkali Creek Area

The primary resource uses of this area, which is proposed for disposal, are grazing, big game hunting and wildlife habitat.

Timber volume is estimated to be about 1,084 MBF. The Forest's Timber Management Plan classified the entire disposal area as non-forest mainly because of isolated, scattered stands, sparseness, and size classes of timber involved. There are no sales planned for the area now or in the future.

Estimated grazing capacity is 730 AUM's on 4,117 usable acres of the Gothic C&H allotment.

The topography is characterized by a relatively flat, sagebrush-grass park in Alkali Basin, moderate north slopes of Flat Top Mountain and moderate south slopes of Red Mountain. Big game migrate across the Basin from and to the two timbered mountains. There are elk calving and deer fawning grounds on the disposal area. Grouse and rabbits are the main small game species living in the area. Raptors use the area for hunting on a limited basis. Bald eagles scavenge from the Roaring Judy Fish Hatchery, about 2 1/2 miles southeast of Alkali Basin.

Mineral prospecting has not occurred on the area. However, the entire area has been staked and filed on for mill sites in connection with the Mt. Emmons molybdenum mine. These mill site claims were filed by AMAX, Inc. as a protective measure from third party filing.

Dispersed recreation uses consist mostly of big game hunting. Annual visitor days use is estimated to be 6,000 for big game hunting, and 200 for hiking, picnicking, photography, etc. There are no developed recreation sites on the area and none planned.

The only special use permit involved is for water measuring (weir) device on Alkali Creek issued to AMAX, Inc.

Transportation facilities include the Big Alkali Lake road, the Alkali Basin road and the State School Section road. There are no inventoried trails on the area.

There are about 14 acres of floodplains or connected wetlands in the disposal areas.

Township 51 North, Range 1 East, N.M.P.M. - Teepee Gulch Area

Silver Springs Ranch Tract - Sections 23, 24, 25 and 26

This 920 acre property, which is proposed for acquisition, is located just east of Almont, Colorado (see Appendix E, Figures E-3 and E-8). Elevations vary from 8,300 to 9,600 feet. The general aspect is west-southwest with slopes of 25 percent. Drainage is westward by Teepee Gulch to the Taylor River. The area has gently sloping and rounded ridge tops. The soils are thin and sandy. The dominant vegetation is sage with intervening grasses. Douglas-fir and aspen patches are common, but none are of commercial value. Other vegetation includes rabbit brush, wildrose, sulphur flower, wildcat daisy, rushes, sedges and willow.

Cultural values include two prehistoric sites, lithic scatter and other artifacts, and one historic site of undetermined significance. The extent, significance and potential for cultural values cannot be made without further examination and evaluation.

Recreation use of the area is limited to non-existent. The area does not qualify for wilderness or natural area designation. The potential for recreational development is low.

The area has extensive, above-average value for wildlife, mainly mule deer, elk, bighorn sheep, and sage grouse habitat. A small, transient bald eagle population uses the area for hunting. Estimated big game use is 300 animal unit months in summer, 1,400 in winter and 900 in spring-fall on the Lost Canyon C&H allotment. About a third of this use occurs on the private land.

The area shows signs of extended past livestock overgrazing. Application of recognized range management practices could return the area to more production in a reasonable time. Private land boundary fencing excludes this area from the Lost Canyon C&H allotment. Range condition on private land is rated poor on a sage-Idaho fescue range type.

Watershed protection values are high on the area because the protective plant cover is rated fair to good.

There are no wetlands or floodplains on the area.

The Silver Springs property is located in an area of above average public use need. It is of sufficient size to offer a wide variety of multiple use management alternatives. The property is attractive for inclusion into federal administration, as it is completely surrounded by National Forest.

Townships 50 and 51 North, Range 2 East, N.M.P.M. - Leaps Gulch Area

This 1,280 acre property, which is proposed for acquisition, is located about 4 miles southeast of Almont, Colorado. Elevation varies from 9,000 to 10,000 feet. The area slopes generally toward the west, and is drained mostly by Leaps Gulch, which flows into the Gunnison River. The generally rolling terrain has moderately developed surface soils, but rocky areas and outcrops are common. The dominant overstory vegetation is aspen with an understory of three leaf sage. Ground cover is dominated by a wide variety of grasses.

No prehistoric sites or artifacts are known to exist on the area. There is substantial potential for prehistoric and moderate historical resources in the general area, based on literature. However, the elevation of the tract probably restricts this potential.

Moderate use by four-wheel drive explorers, campers and hunters is made of this property.

The on-site scenic values are low, but the views of West Elk Wilderness and the Gunnison River Valley are moderate to high quality.

This property has average to above-average wildlife values. The area is used extensively by migratory elk and to a lesser degree as winter range. This tract provides valuable summer range and limited winter range for mule deer. It also provides excellent sage grouse habitat. Bighorn sheep might use the tract under severe winter conditions.

The property is now being grazed lightly by livestock. It has moderate productivity. A conservative long-term range management program could be expected to improve general range values, conditions and carrying capacity. Private land fencing partially excludes this property from the Lost Canyon C&H allotment. The range condition is rated "fair" to "fair plus" on the aspen-fescue range types.

There is no commercial timber on this property.

Watershed protection conditions are good in the aspen, but only fair for the grassland areas.

There are no wetlands or floodplains on the property.

Livestock grazing is the dominant present use and it has been heavy enough to reduce wildlife and watershed values. The present multiple use value is regarded as moderate.

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Arapaho-Roosevelt National Forest

Township 4 North, Ranges 71 and 72 West, 6th P.M., Colorado
Sections 26, 27, 34 and 35
Township 3 North, Range 72 West, 6th P.M., Colorado
Section 3
Big Meadows Tract - Boulder and Larimer Counties

This 650 acre area, which is proposed for acquisition, is located about 8 miles northwest of Lyons, Colorado, at an elevational range of 6,700 to 9,100 feet (see Appendix E, Figures E-1 and E-6). All of the area has steep slopes of 30-60 percent which are generally rocky. The aspect is mostly northeast and southwest. The area is drained by the West Fork of the Little Thompson River, a tributary to the South Platte River. In spite of the rocky character of the area, where surface soils do occur, they are moderately deep, gravelly sandy loams, derived from granite and schist. The dominant vegetation is ponderosa pine and Douglas fir. A vigorous growth of grass and shrubs is invading the open understory.

The quality of the environmental values of the property are degraded by the Big Elk Meadows private real estate development (subdivision).

The area is typified by rugged terrain and common landscape setting. Scenic values are degraded by private land development backdrop.

No historical or prehistoric sites are known nor is there any record of an archaeological survey. The potential for prehistoric cultural resources is considered to be low.

The opportunities for public recreation, presently or in the future, are restricted because the proposed reclassification area surrounds a private development where access is controlled and water resources are limited. However, a potential for development of low to moderate recreation opportunities is possible.

The area provides average habitat for mule deer, elk, mountain lion and bobcat. Recently reintroduced bighorn sheep might use the general area on a limited basis. Future wildlife values will likely differ from present values because of the extensive adjacent private land housing development.

The area does not have present or potential livestock grazing values or use.

Commercial timber is lacking. Bark beetles and spruce budworm have killed the accessible sawlog-size trees.

Watershed protection values are high because the locality is subject to large storm rainfall events. Existing flood protection values are moderate due to the low potential for water storage.

Limited wetland is present on the property in Section 30, Township 4 North, Range 71 West. Flood plains exist on this property because of the West Fork of the Little Thompson.

Present multiple use values are for watershed protection, wildlife and scenery. Not much change is expected to occur in these uses.

Township 4 North, Range 71 West, 6th P.M., Colorado
Sections 18, 19, 29 and 30
Township 4 North, Range 72 West, 6th P.M., Colorado
Sections 13 and 15

These areas, comprised of about 680 acres and proposed for acquisition, lie along Muggins Gulch, 10-12 miles northwest of Lyons (see Appendix E, Figures E-1 and E-6). Steep side slopes (30 to 60 percent) are characteristic of the area. The canyon walls are dissected by narrow steep drainages containing intermittent streams. The dominant vegetation is ponderosa pine, Douglas-fir and lodgepole pine, considered not to be of commercial value. A vigorous growth of grass and shrubs is invading the open understory. Soils are generally highly erosive and thin decomposed granite. The area is typified by rugged terrain, which has high scenic values.

No historical or prehistoric sites are known to exist on the properties nor is there any record of cultural resource inventory. The potential for prehistoric cultural resources is considered to be low.

The opportunities for public recreation are unlimited. This area receives high dispersed recreation use because of its close proximity to large population centers. Highway 36, a heavily used highway between Boulder and Estes Park, serves as the major access to the area.

These areas provide above-average habitat for mule deer, elk, mountain lion and bobcat. The areas have limited livestock grazing values because of the steep topography and sparse vegetation.

Watershed protection values are high because the locality is subject to intense rainfall events. Flood protection values are low due to limited water storage potential.

Wetlands occur along the creek bottoms, but floodplains do not exist because of the steep canyons.

Multiple use values are for dispersed recreation, wildlife habitat, scenery and watershed protection.

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San Juan National Forest

Township 42 North, Range 8 West, N.M.P.M., Colorado

This 24-acre parcel, which is proposed for acquisition, is located about 1 1/2 miles west of Red Mountain Pass and 10 miles north of Silverton, Colorado in San Juan County (see Appendix E, Figures E-4 and E-9). Elevation is about 12,500 feet and above timberline. There are two or parts of two ponds on the tract which are shallow and incapable of supporting fish life. The "infamous" Black Bear four-wheel drive road passes through the tract. There are no known cultural or archaeological resources on the tract. Minimal sheep grazing occurs on the parcel. There are no known threatened or endangered plant or animal species or their habitat present in the tract. There is insignificant wetland area but no floodplains on the tract.

Resource management in the area would not materially change if the tract was classified for acquisition and acquired.

There has been no recent mineral activity on these patented mineral surveys.

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White River National Forest

Township 7 South, Range 89 West, 6th P.M., Colorado
Sections 17, 21, 28 and 29

These 640 acres (in two separate parcels), which are proposed for acquisition, are located about 6-8 miles south of Glenwood Springs, Colorado near Sunlight Ski area in Garfield County (see Appendix E, Figures E-5 and E-10). There is no vehicular access to the properties. Several intermittent drainages bisect the properties. Topography is characterized by east facing, steep, oak-covered slopes. Elevations range between 7,000 and 8,000 feet. The areas provide above-average habitat for mule deer, elk, small game and upland birds.

There are no wetlands or floodplains on the properties. No historical or prehistoric sites are known to exist on the properties.

ADVANTAGES TO THE UNITED STATES

Gunnison National Forest

Township 13 South, Ranges 86 and 87 West, 6th P.M.
Township 14 South, Ranges 86 and 87 West, 6th P.M.
Township 15 South, Ranges 85 and 86 West, 6th P.M.

Implementing the proposed classification plan through land ownership adjustment programs would straighten interior property lines; would reduce the length of interior property lines by 14.5 miles for savings of about $72,500; would eliminate the need to maintain 83 interior property corners for a savings of about $8,300; would provide for more effective and efficient public and private resource management and development through land consolidation; would eliminate the need to acquire four rights-of-way for public access and would result in a better balanced and more optimum landownership pattern.

Township 51 North, Range 1 East, N.M.P.M.
Townships 50 and 51 North, Range 2 East, N.M.P.M.

Implementing the proposed classification through landownership adjustment programs would straighten and reduce the length of interior property lines by 18 miles for a savings of about $90,000; would eliminate the need to maintain 32 interior property corners for a savings of about $3,200; would eliminate the need to acquire five rights-of-way for public access; and would provide for more effective and efficient federal range and wildlife resource management programs through land consolidation.

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Arapaho-Roosevelt
National Forest

Township 3 North, Range 72 West, 6th P.M.
Township 4 North, Ranges 71 and 72 West, 6th P.M.

Implementing the proposed classification through landownership adjustment programs would reduce the length of interior property lines by 71.25 miles for a savings of about $350,000; would eliminate the need to maintain 201 interior property corners for a savings of about $20,000; would provide for greater recreation and wildlife resource management and watershed protection possibilities; would eliminate the need to acquire 29 rights-of-way for public access; would place an additional 1/2 mile of the Little Thompson River and its associated riparian areas and about 3 1/2 miles of Muggins Gulch under National Forest management, thus making them available and accessible for public use and enjoyment, and would complement prior acquisitions by increasing usable public use areas which would reduce the possibility of public use on private lands.

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San Juan National Forest

Township 42 North, Range 8 West, N.M.P.M.

Implementing the proposed classification through landownership adjustment programs would reduce the length of interior property lines by about 1.6 miles for a savings of about $8,000; would eliminate the need to maintain eight interior property corners for a savings of about $800, and would eliminate the need to acquire a right-of-way for the Black Bear road for public access.

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White River National Forest

Township 7 South, Range 89 West, 6th P.M.

Implementing the proposed classification through landownership adjustment programs would reduce the length of interior property line by about 3.75 miles for a savings of about $18,750; would eliminate the need to maintain 10 interior property corners for a savings of about $1,000, and would provide for more effective and efficient public resource management development and use through land consolidation.

DISADVANTAGES TO THE UNITED STATES

Gunnison National Forest

Township 13 South, Ranges 86 and 87 West, 6th P.M.
Township 14 South, ranges 86 and 87 West, 6th P.M.
Township 15 South, Ranges 85 and 86 West, 6th P.M.

Disposal of additional public land would enlarge private inholdings which may prevent future acquisitions to facilitate changes in resource management programs, or at least be more remote and more costly. This would be offset by the acquisition of private land, which is more suitable for multiple use management purposes and public use.

Township 51 North, Range 1 East, N.M.P.M.
Townships 50 and 51 North, Range 2 East, N.M.P.M.

There are no definite disadvantages evident to the classification proposed for these areas. The county would lose tax base land by Federal acquisition of private land, but would gain in Payment in

Lieu of Taxes (PILT) and in revenue from the 25 percent National Forest receipts program.

Arapaho-Roosevelt National Forest

Township 3 North, range 72 West, 6th P.M.
Township 4 North, Ranges 71 and 72 West, 6th P.M.

Acquisition of private lands would require more intensive and accurate land line location, posting, and marking and would increase administrative and enforcement costs to prevent adjacent private land development from encroaching on acquired lands. Landownership adjustment programs would reduce the county's tax base land, but they would gain in PILT and in revenue from the 25 percent National Forest receipts program.

San Juan National Forest

Township 42 North, Range 8 West, N.M.P.M.

There are no definite disadvantages to the classification proposed for this area. Landownership adjustment programs would reduce the county's tax base, but it would gain in PILT and National Forest receipts program.

White River National Forest

Township 7 South, Range 89 West, 6th P.M.

There are no definite disadvantages to the classification proposed for these areas. The county would lose tax base land by federal acquisition of private land, but would gain in PILT receipts and revenue from the National Forest receipts program.

OTHER IMPACTS

PAGE REFERENCE

Local Source Materials. . 248
Potable Water 249
Coal Creek Watershed. . . 251
Short-Term Uses versus Long-Term Productivity. 252
Irreversible and Irretrievable Commitment of Resources. 254
Cumulative Impacts. . . . 256

LOCAL SOURCE MATERIALS

An estimated 200 acres will be disturbed for AMAX's sand and gravel requirements (Appendix A, page 292). Some additional acreage may also be disturbed to supply sand and gravel for growth-related construction.

The impacts of sand and gravel extraction will be similar for any site used, with site selection being subject to County approval and site design being subject to both

County and State controls. Vegetation and non-migratory wildlife will be destroyed during site development, and a visual contrast with any surrounding rural scenery will be likely. Water quality problems are not expected due to County and State environmental controls. Some fugitive dust will likely be emitted during operations. Depending on location, some traffic congestion may also result.

In the reclaimed state, vegetation and wildlife will return to the area, but a new topography will exist. Water bodies may also be created.

AMAX has not announced where its coal will come from, but its estimated annual needs will be approximately 48,000 tons. If local coal is used and if a currently active source provides it, the impact will be minor. If a new local source is developed, impacts will resemble those of any small coal mine. More precise details are not available. If the coal is imported, it will probably come from an active source.

The impacts of cutting and processing wood for Project needs are discussed in environmental documents written for timber harvesting. However, there is no indication that AMAX will initiate timber harvest specifically for this project.

POTABLE WATER

Detailed information on potable water requirements are not available, but the bulk of potable water consumption will take place at the mine rather than the mill because that is where most of the employees will work.

AMAX proposes constructing a 500 acre-foot reservoir on Carbon Creek for its primary potable water source, and it has filed for a 2.25 cubic feet per second junior water right on Carbon Creek to fill it (Water Division No. 4, Case No. 80CW465). (The Forest Service has filed a Statement of Opposition on this filing.) The reservoir will require a Seciton 404 Dredge and Fill Permit from the Army Corps of Engineers.

As a secondary source, AMAX is also considering a 200 acre-foot reservoir on Elk Creek west of the mine site (Case No. 80CW462). (The Forest Service has filed a Statement of Opposition on this filing.) The primary source of water for this reservoir is the Slate River (Case No. 80CW463), with a point of diversion near the Oh-Be-Joyful confluence. Construction of a diversion and pumphouse facility on the Slate River will require a Section 404 Dredge and Fill Permit. Some Elk Creek water may also be involved.

Water will be pumped from these reservoirs to the mine and mill, where it will be treated and stored in tanks.

The dominant surface impact of this system will relate to the two reservoirs. The Carbon Creek reservoir will bury or flood 24 acres, while the Elk Creek reservoir will similarly affect 43 acres.

Vegetation that will be covered is listed in Table 4-53.

Approximately 2 acres of riparian willow wetlands will be covered by the Carbon Creek reservoir, while about 1 acre of similar wetland will be

TABLE 4-53. ACRES OF POTENTIAL VEGETATION DISTURBANCE: POTABLE WATER SUPPLIES

VEGETATION TYPE	Carbon Creek Reservoir	Elk Creek Reservoir	Access Roads
Spruce-fir	10	43	
Aspen	12		
Subalpine meadow	2		
Variable			29

covered by the Elk Creek reservoir. In both cases, the flood buffering and sediment removal functions of these wetlands will be duplicated by the reservoirs. Some new wetland will probably develop at the inlets.

Carbon Creek supports a fishery, and installation of the reservoir will remove approximately 1,500 feet of fishable channel. In its place a lake fishery will develop, but it is likely that access will be limited because of the water's use for drinking purposes. A similar conflict is not anticipated at the Elk Creek reservoir.

The visual impacts of the two reservoirs will be minimal once revegetation is completed.

The installation of either reservoir could interfere with the maintenance of favorable conditions of flow downstream. High flows from snowmelt runoff flush accumulated sediment through the system, and low flows sustain riparian vegetation that helps maintain channel stability. In addition, fish fare poorly when flows get too low. Detailed impact predictions cannot be made at this time because hydraulic studies on flow needs are not completed, and also because AMAX's water rights filings have not been adjudicated.

Reduction of Carbon Creek flows below natural low-flow levels would probably damage the existing fishery because late-season flows are already low. Studies are currently underway to determine what flows are needed to retain the existing fishery. Releases from the reservoir could be used to maintain the needed flow if AMAX agrees to do so, or if required by the Forest Service or the terms of AMAX's water decree. AMAX has proposed acquiring the reservoir site from the Forest Service through land exchange. If this occurs, the Forest Service's opportunity to regulate releases will be diminished.

Reduction of Elk Creek flows could result in a loss of riparian vegetation, which in turn could impair channel stability and lead to increased channel erosion. Increased sediment loadings in

Coal Creek would ensue. Studies are currently underway to determine the flows needed to prevent this. As with the Carbon Creek reservoir, releases could be used to maintain the necessary flows if AMAX agrees to do so, or if required by the Forest Service or the terms of AMAX's water decree. AMAX has not identified the site for acquisition by exchange.

AMAX proposes leaving these reservoirs in place following reclamation and opening them to public recreation use.

A lesser component of the potable water system will be pipelines connecting water sources with reservoirs and work areas. In many instances these pipelines will be placed under the railroad beds or the access road beds and will generate no impacts of their own. In other instances the pipelines may have to be routed separately, in which case there will be minor local disturbances during construction, followed by the existence of a narrow corridor during operation. The corridor effect would be obliterated by reclamation.

COAL CREEK WATERSHED

The Coal Creek watershed has been the focus of controversy. It provides the Town of Crested Butte with its water supply and it is a major entryway into an area which receives considerable recreation use. The impacts of the Mt. Emmons Project on it are discussed in many places throughout this draft EIS, but because the watershed is an important issue, highlights of these discussions are summarized below. Particular attention is paid to those matters involving public issues and agency concerns.

Impacts of AMAX's Proposal

Water - AMAX's proposal will probably increase suspended sediment in Coal Creek during runoff events. Under ordinary circumstances it is unlikely that the Coal Creek fishery or the Coal Creek channel will suffer from this, but the sediment will probably tax the already-strained treatment facility used by the Town of Crested Butte. Sediment increases will be greatest during construction, but will resemble existing levels once the project is in operation.

The risk of accidental chemical or fuel spills will not be completely avoidable, but AMAX proposes several measures to control the degree of risk.

The risk of acid drainage several decades hence cannot be avoided. This risk takes two basic forms: leakage through the mountain's fracture systems, and leakage around sealed mine workings. The former is independent of the mine site's location, but the latter is not. AMAX intends to analyze techniques for controlling acid drainage in more detail once better underground information is available.

Air - AMAX's proposal will have local impacts on air quality during both construction and operation, but the Town of Crested Butte's water supply will not be affected.

Visual Resources - The mine site will be partially visible from the east side of the Town of Crested Butte. Travellers driving west will also see parts of the site from a few locations along the Kebler Pass road. But most of the site will be screened from view because it lies upslope of the Kebler Pass road.

The Coal Creek crossing and the fill associated with it will be a major feature on the Kebler Pass road. However, when revegetated (which should occur in the 1990's), this impact will be substantially reduced.

Outdoor Recreation - The Project will not have much effect on outdoor recreation. While up to 4,000 feet of channel will be lost to fishing, that particular area does not currently receive much fishing use.

Possible Mitigation

Certain steps could be taken to minimize the impacts discussed above. These include the following:

(1) Avoid activity in Coal Creek (Alternative 4). This keeps Project activities out of the municipal watershed. Overall Project costs may be slightly higher and the visual impact on the Town of Crested Butte would be larger, but the Coal Creek watershed would be left untouched.

(2) Move the Coal Creek fill to the mine site (Alternative 7). For traffic on the Kebler Pass road, the fill will be the most noticeable feature of the Project. Its placement may also generate suspended sediment at times. Both of these impacts could be avoided by hauling the fill material to the mine site, which would cost approximately $2.8 million (1980 dollars). (A certain amount of surface area will be needed for equipment and supplies during tunnel construction. If this area can be provided only by placing some fill across the valley bottom, then this would be an imperfect mitigation because the impacts are only reduced, rather than eliminated. In addition, truck traffic hauling the fill away will raise noise levels while the tunnel is being driven.)

(3) Reposition the fill as necessary to avoid water quality degradation at the water intake (Alternative 3). This would create addiitonal space that might be needed for treatment facilities to maintain water quality at the intake.

(4) Move the fill below the intake.

(5) Move the intake above the fill.

(6) Improve the Town's water treatment system.

(7) Relocate the intake to another watershed.

THE RELATIONSHIP BETWEEN SHORT-TERM USES OF MAN'S ENVIRONMENT AND THE MAINTENANCE AND ENHANCEMENT OF LONG TERM PRODUCTIVITY

All of the mining alternatives involve a short-term commitment of resources for development of the Project. This section describes the relationship between this short-term use of the environment and potential future long-term uses. Short-term is defined as the life span of the mine-mill facility (30 years) plus a ten-year recovery period in which abandonment and recovery efforts would be completed (40-year total). The short term lasts until the year 2020. Long term is defined as the future after the year 2020.

Vegetation

The short-term use of the Project area will remove an insignificant portion of the available regional rangeland base. The long-term productivity of the vegetation in the Gunnison Basin will not be significantly changed by the Project.

The mining operations on Mt. Emmons could deplete natural acid seepage, resulting in significant drying of the Iron Bog. This may result in loss of some specific biological populations and represent a significant long-term impact. In the very long term, however, natural succession will probably dry the Iron Bog regardless of mining activities.

Wildlife

The impacts of the Project on wildlife (temporary and permanent loss of wildlife habitat) will not affect the long-term productivity of wildlife resources. Significant wildlife species or habitats would not be adversely affected.

Topography

Short-term use of the Project area will create a long-term topographic change at the mine site, tailing area, and subsidence zone.

Water

Approximately 3,000 acre-feet of water will be consumed annually. This will not affect long-term water yields. Water quality may deteriorate at times during the Project, but over the long-term it will not be significantly affected, except in the Mt. Emmons area where acid seepage could eventually occur.

Air Quality

The Project will create local short-term increases in total suspended particulate levels. Project emissions will not violate state and Federal air quality regulations or standards. In the long term, there need be no long-term effect on air quality, except possibly from secondary sources.

Noise

Minor short-term noise impacts will result. These effects will not be significant. They will not affect long-term noise levels.

Cultural Resources

The Project will impact the integrity of cultural resource sites. The affected sites would be salvaged and their characteristics recorded for the interpretation and understanding of future generations.

Visual Resources

Short-term visual impacts in the Project area will not significantly change the visual character of the landscape over the long-term.

Outdoor Recreation

Increases in local population will increase the use of recreation facilities, with possible capacity problems in the short term. Over the long term, local recreation capacity will not be significantly affected by the Project.

Transportation

In the short term, automobile traffic increases will significantly increase congestion on Colorado 135 north of Gunnison. Traffic accidents would increase proportionately. These effects would not continue into the long term.

Socioeconomics

Over the short-term, local economic conditions will adjust to the Projects's initiation, and later to its departure.

Geologic Setting

The subsidence area will disturb local geologic features over a maximum area of 900 acres. Removal of ore and waste materials will be permanent; the disturbance is considered long term. Removal of the ore will preclude future use of the resource.

Soils

Minor site-specific reductions in soil productivity will occur over the short term, but these will be negligible compared to the total soil base in the general Project area. Over the long-term, most of the short-term losses will be restored.

Land Use

Approximately 3,000 to 5,000 acres of land will be changed from open space and grazing uses to residential and industrial uses. In the long term, approximately 400 to 500 acres will be returned to open space and grazing; 600 to 1800 acres will remain in residential and ancillary use; and between 2000 and 2700 acres will remain as the unreclaimed subsidence area and tailings area.

Grazing - The Project will result in the long-term loss of 110-770 AUMs per year, assuming the worst case. As a result of urban growth related to the Project, the worst-case effect on cattle production in Gunnison County could be a reduction of from 2-7 percent of 1978 herds. This loss will not significantly affect the long-term productivity of Gunnison County.

Mineral Resources - About 155 million tons of molybdenum ore will be removed in the short term. The molybdenum ore produced at the mine will benefit the nation in the short term by satisfying part of the nation's demand for this metal. It is not certain what effect changing technology and economic conditions could have on mining this ore body in the future.

IRREVERSIBLE AND IRRETRIEVABLE COMMITMENTS OF RESOURCES

This section identifies the irreversible and irretrievable commitments of resources resulting from the proposed action. The term irreversible is defined as use that is incapable of being reversed. Once something is initiated, it will continue. The term irretrievable means irrecoverable; once something is used it is not replaceable.

Vegetation

Construction of Project facilities and secondary urban development will involve removal of vegetation from 3,000 to 5,000 acres. Under worst-case analyses, only 419 acres of the mine-mill complex and 11 acres of the transmission line would be revegetated.

Wildlife

Under worst-case analysis, about 1,839 acres of wildlife habitat could be irreversibly committed due to subsidence and tailing disposal.

Energy Resources

Petroleum products, coal, and electricity will be expended to mine and process the ore. The use of these energy-producing resources is irreversible and irretrievable.

Water Resources

Mining, milling, and associated activities will irretrievably consume approximately 3,000 acre-feet of water annually.

Cultural Resources

Project construction may result in the excavation of cultural resources as a salvage measure. The loss of the integrity of the affected sites will be an irreversible and irretrievable commitment.

Visual Resources

Major landform changes resulting from the Project will be irreversible. They include the mine pad, the tailing disposal area, and the subsidence zone. The current landscape in these areas will be irretrievable.

Socioeconomic

Human labor devoted to the Project will be irretrievable. Industrial materials used will generally be irretrievable. Local socioeconomic conditions will change, but not necessarily in either an irreversible or irretrievable manner.

Geologic Setting

The geologic formations of Mt. Emmons will be irreversibly changed by the removal of waste rock and ore, and by eventual subsidence. The molybdenum extracts produced by the mill, once shipped to market, will be irretrievable in many cases.

Soils

Soils covered by the tailing disposal area, mine site, and mill site will irretrievably lose their productivity. The most productive soils in these areas, however, will be stockpiled for use in reclamation.

Land Use

Under worst-case analysis, approximately 1,917 acres of land will be irreversibly committed at the mine and mill sites, and approximately 600 to 1,800 acres will be irreversibly committed for housing and other demands requiring land development.

Grazing production lost during mine operation will be irretrievable.

CUMULATIVE IMPACTS

Discussions of socio-economic impacts throughout this draft EIS incorporate other reasonably foreseeable future actions. See BMML (1981a-d). The Environmental Protection Agency (EPA) recognized this fact and cooperated with the Forest Service in preparing the Mt. Emmons EIS. EPA may use the EIS's impact analysis in assessing the need for wastewater facilities due to secondary growth.

Discussions of electrical power supply also incorporate reasonably foreseeable actions. The Rural Electrification Administration (REA) recognized this when indicating it may use the Mt. Emmons EIS toward fulfilling its NEPA requirements. REA's federal actions may include the approval of a power sales agreement or the approval of transmission line construction contracts for the Project.

Other related environmental studies are being processed or have been identified as possibilities. Some of these studies are included in a scoping document (Forest Service 1979b). Studies not listed previously include the Oh-Be-Joyful Wilderness study prepared by the Forest Service and a wastewater planning study funded by the EPA for the City of Gunnison.

The Mt. Emmons Project will contribute cumulatively to anticipated population growth in Gunnison County and western Colorado. The combination of large oil shale projects in the Rifle area, a CO_2 pumping project near Cortez, and coal mining in the North Fork Valley, will compete for labor and resources. Cumulative population projections to 1990 have estimated a population increase of 55,200 in the seven west slope counties of Delta, Garfield, Gunnison, Mesa, Montrose, Ouray and Pitkin (BLM, 1979). Growth related to the Mt. Emmons Project could constitute about 15 percent of the cumulative growth estimated for these counties.

The electrical power used to operate the mining operation, if generated at coal-fired plants, could require burning approximately 117,000 tons of coal annually. While the electricity used at the Mt. Emmons Project will be a small portion of the total electrical power consumed in Western Colorado, it may add cumulatively to uncertain environmental effects.

The molybdenum removed from Mt. Emmons will add to the available domestic supply of the metal. This added supply will contribute positively to the national economy and social well-being.

Based on information available at this time, the Mt. Emmon's Project is not expected to cause other cumulatively significant impacts.

CHAPTER 5. LIST OF PREPARERS

CHAPTER 5. LIST OF PREPARERS

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Mt. Emmons Project: Responsible for coordination and management of Forest Service studies and proponents data base relating to biological environments, energy, electrical power transmission, cultural resources, transportation, land uses and Forest Service management impacts. Principal author of EIS text relating to the above topics.

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GRAPHICS

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Graphic materials for the Mt. Emmons Environmental Impact Statement were prepared by Creative Graphics of Gunnison, Colorado through competitive contract #53,82X9-0-082 issued to Connie E. Schlepp by the Forest Service.

CONSULTATION AND COORDINATION

The Grand Mesa, Uncompahgre and Gunnison National Forests implemented public and interagency consultation and coordination throughout the development of this EIS. This process included meetings with affected Federal, State, and local agencies; public meetings, and correspondence with concerned interest groups and individuals. All comments were given consideration in the preparation of this Draft EIS.

Listed below are Federal Cooperating Agencies and other federal agencies that were contacted for consultation and coordination purposes:

Cooperating Federal Agencies

Army Corps of Engineers
Bureau of Land Management
Bureau of Mines
Bureau of Reclamation
Department of Energy
Department of Housing and Urban Development
Environmental Protection Agency
Federal Highway Administration
Fish and Wildlife Service
Geological Survey
National Park Service
Rural Electrification Administration
Soil Conservation Service

Other Federal Agencies

Agricultural Stabilization and Conservation Service
Council for Historic Preservation
Department of Commerce
Department of Health, Education, and Welfare
Department of Labor

COLORADO JOINT REVIEW PROCESS

The Mt. Emmons CJRP was formally initiated on June 28, 1978 with the signing of a Joint Statement by representatives of the Forest Service, Colorado Department of Natural Resources, and Gunnison County.

The Mt. Emmons Project was the first major mining project in Colorado to fall under the Colorado Joint Review Process (CJRP). CJRP was established to serve as a forum for the exchange, discussion, and dissemination of Project-related information. Formal participating members in CJRP were the Forest Service, Gunnison County, Colorado Department of Natural Resources, and AMAX. Representatives of local community governments and other federal and state agencies were also involved. Open public meetings chaired by a representative of Gunnison County were held on a regular (usually monthly) basis.

DRAFT EIS AVAILABILITY

Copies of the Draft EIS and microfiche copies of all technical information incorporated by reference can be found at the following places:

Forest Service Offices

USDA-Forest Service
Washington Office
South Building
12 & Independence S.W.
Washington, D.C. 20013

USDA-Forest Service
Regional Office-Denver
11177 W. 8th Avenue
Lakewood, CO 80225

USDA-Forest Service
Regional Office-San Francisco
630 Sansom Street
San Francisco, CA 94111

Supervisor's Office
Grand Mesa, Uncompahgre, and Gunnison National Forests
1063 Main Street
Delta, CO 81416

Taylor River Ranger District
216 N. Colorado Avenue
Gunnison, CO 81230

Libraries

Denver Public Library
1357 Broadway
Denver, CO 80203

Morgan Library
Colorado State University
Fort Collins, CO 80523

Norlin Library
University of Colorado
Campus Box 184
Boulder, CO 80309

Jefferson County Library
10200 W. 20th Avenue
Lakewood, CO 80215

Savage Library
Western State College
Gunnison, CO 81230

Appendix J contains a list of the DEIS distribution.

APPENDICES

Appendix A. AMAX's Mitigation, Avoidance, and Enhancement Measures 261
Appendix B. Mitigation Measures 301
Appendix C. Project Layout Details 327
Appendix D. Power Supply Details 345
Appendix E. Land Classification Details 353
Appendix F. Land Exchange Details 365
Appendix G. Project Schedule 374
Appendix H. Reference Guide for Issue Analysis 375
Appendix I. Methodology 379
Appendix J. Statement Distribution. 387

APPENDIX A. AMAX'S CHAPTER 7 (AMAX, 1981a)

This Appendix contains mitigation measures proposed in Chapter 7 of AMAX's Environmental Report. The mitigation measures apply to Alternative 2. Although this is a reproduction of AMAX's Chapter 7, AMAX's figures are not included. References to these figures and to other material in AMAX's Environmental Report have not been deleted. A copy of the Environmental Report will have to be obtained in order to locate these references.

PAGE REFERENCE

7.1 Socioeconomics 262
  7.1.1 Growth Management 262
  7.1.2 AMAX Growth Management Staff. 264
  7.1.3 AMAX Financial Assistance 264
  7.1.4 Community Preparation for Growth. 265
  7.1.5 Growth Management Programs. 266
  7.1.6 Community Services Programs 268
7.2 Natural Environment. 270
  7.2.1 Physical Environment. 270
  7.2.2 Biological Environment. 279
  7.2.3 Cultural Environment. 284
7.3 Surface Reclamation. 290
  7.3.1 Disturbance of Surface Lands. 290
  7.3.2 Reclamation Plan. 292

7.0 MITIGATION, AVOIDANCE, AND ENHANCEMENT MEASURES

AMAX has incorporated the mitigation of adverse impacts and enhancement of positive impacts into the design and planning of the Mount Emmons Project. The major conclusion of this chapter is that adverse environmental, social, and economic impacts of the Mount Emmons Project can be mitigated to the extent that net benefits will result from the Project. The discussion focuses on socioeconomics, the natural environment, and reclamation of surface disturbances.

To be effective, mitigation programs must be flexible and adaptable to meet changing conditions. Permit conditions must be met, but a mitigation plan should go beyond those conditions.

7.1 SOCIOECONOMICS

Growth not associated with the Mount Emmons Project is projected to increase the County's population from 12,628 people in 1980 to 18,920 people in 1994. With the Mount Emmons Project, the population is projected to increase to 25,697 by 1994 (BMML 1980). These figures show the total annual average growth rate to be 5.2 percent during this 14-yr period and the Mount Emmons direct and induced population would account for 26 percent of the County's total population by 1994. The effects of this growth were described in Section 4.2 for the growth not associated with the Mount Emmons Project, and in Section 5.6 for the growth associated with the Mount Emmons Project. The purpose of the mitigation activities which are outlined in Section 5.6 and discussed in more detail in this section are to avoid or mitigate the adverse impacts of growth which may be associated with the proposed 20,000 tpd Mount Emmons Project, and to take maximum advantage of the positive benefits. In order to accomplish this, a coordinated growth management program is necessary.

7.1.1 GROWTH MANAGEMENT

Growth management may be described as an effort to maximize the advantages, and minimize the disadvantages, of population growth. This may require efforts to influence the rate of population growth, the location of population growth, and the type and level of governmental and private sector services. A successful growth management program requires a high level of coordination, cooperation, and commitment by the community, government, and the private sector, including industry.

Government and the private sector normally provide the necessary services and facilities to accommodate population growth. The availability of services and facilities, including housing, transportation, schools, and commercial centers, coupled with the availability of jobs, generally dictate where population growth will occur.

Growth is expected to occur in this region without the Mount Emmons Project. The development of the Project will add to the facilities and services which must be provided by government and the private sector, and it may be difficult for these sectors to provide timely financing for the necessary services and facilities. The population growth associated with the development of the Mount Emmons Project will increase the per capita assessed property tax valuation to $16,054 in 1994, compared to a per capita assessed valuation of $8,773 without Project development. If the demand for basic services and facilities directly attributed to the development of the Mount Emmons Project occurs in advance of the revenues needed to pay for those services and facilities, AMAX will cooperate in assuring availability of the necessary funds to assist local agencies in overcoming this problem.

AMAX has had a special interest in growth management issues since the earliest stages of the Mount Emmons Project. This interest was demonstrated by: (1) the establishment of a Community Affairs Office in Gunnison staffed by employees who have prior experience in government and in growth management programs; (2) the creation of a Community Affairs Team comprised of consultants with expertise in community development; and (3) the creation of a Community Development group in AMAX's Environmental Services, Inc. subsidiary. These activities are described more fully in Section 7.1.2.

AMAX has also participated in a variety of activities to help the community prepare for growth. These activities include the development of the ROMCOE-sponsored tour of rapid growth communities for local officials, financing the technical assistance and growth impact assessment work by BMML, and direct financial and technical assistance to local agencies to prepare for growth.

AMAX has played a significant role in helping the community understand the potential impacts of growth generated by the Mount Emmons Project and in preparing for that growth. This high level of participation at an early stage, coupled with the substantial amount of time between the discovery of the Mount Emmons ore body and the proposed start of construction in 1982, provide a unique opportunity for successful growth management.

AMAX's growth management programs in Gunnison are based on four major assumptions:

1. Growth management programs must be adaptive to changing conditions.
2. Growth management programs include a commitment to help build local capacity to prepare for and accommodate growth.
3. Growth management programs must be coordinated with existing public and private institutions to strengthen those institution's abilities to provide services and facilities.
4. Growth management programs will be designed to facilitate and encourage growth in and near the city of Gunnison.

Each of these assumptions and their application to the Mount Emmons Project will be discussed in this chapter.

7.1.1.1 Adaptive Growth Management

Successful growth management requires an adaptive process to adjust programs and financial commitments to deal with impacts as they develop. Changing local, state, national, and international trends make it very difficult to accurately predict changes into the future. In fact, it is often difficult to assess the cause and effect of those changes that happen today.

While certain social and economic impacts can be accurately determined, others cannot. The cumulative effects of a number of social impacts cannot be accurately determined prior to the occurrence of the impacts. Therefore, it is very important that mitigation be designed to address actual impacts. In order to develop an adaptive growth management process, a high level of cooperation and commitment is necessary from the community and local government leaders. Local officials should have primary responsibility for identifying, and mitigating, growth related impacts affecting the public sector. This is a normal function of government. However, industry must cooperate in both the identification and mitigation process.

One method of achieving necessary cooperation and coordination would be the formation of a local task force. They will monitor, identify, and mitigate the social and economic impacts related to population growth associated with the Mount Emmons Project and growth not associated with the Project. Such a task force could be formed by local government leaders as an advisory body to local government or as an incorporated non-profit agency.

7.1.1.2 Capacity Building

Many of AMAX's past, current, and future growth management efforts involve assisting local agencies to develop the staff and skill needed to provide facilities and services to a growing community. This approach recognizes that some local public and private agencies have difficulty providing services which could be aggravated by growth associated with the Mount Emmons Project and other new developments. Local government and the affected private institutions, such as the local financial institutions and housing industry, will have to expand their services and resources to meet these requirements. By helping the community identify and resolve existing deficiencies in services or facilities, AMAX is also assisting the community in developing the ability to provide future facilities and services.

AMAX's involvement will include both technical and financial assistance. Financial assistance, when possible, will be used to match available local, state, and federal funds.

Gunnison County has already made significant progress in developing programs designed to provide services and facilities to a growing community. Section 7.1.4 outlines some of the initiatives taken by local agencies during the past two years.

7.1.1.3 Growth Management Must Involve Existing Agencies

A successful growth management program must strengthen existing public and private sector agencies. Financial assistance obtained from AMAX, state, or federal programs should be channeled through existing agencies and existing financing mechanisms whenever possible.

AMAX will work with local leaders and the local task force, if one is formed, to assist existing agencies in providing necessary services and facilities needed as a result of population growth related to the Mount Emmons Project. Examples of AMAX's involvement in growth management are described in Section 7.1.3.

The actual mitigation programs will, however, depend on the actual community needs which develop as a result of the Mount Emmons Project and cannot be met by local agencies with existing resources.

Existing agencies will want to provide the necessary services and facilities for the Mount Emmons Project-related population growth and growth resulting from other new development. As identified in Chapters 4.0 and 5.0. Project related growth is projected to account for just over one-half of the total growth in Gunnison County between 1980 and 1994 and one-fourth of the 1994 population. The growth management programs described in this chapter are designed to help insure that existing agencies are capable of providing the services and facilities needed by existing residents and the new residents who will move to the County.

7.1.1.4 Gunnison as the Growth Center

The city of Gunnison is the residential, commercial, medical, transportation, and educational center of the County. It is the County seat and the home of Western State College. Gunnison contains the majority of the County residents. The city of Gunnison and the County Planning Office have indicated a strong desire to have residential growth occur near existing urban centers. This is reflected in Gunnison's City Master Plan.

AMAX's growth management programs are consistent with the desire of local residents that population growth occur primarily in or near the city of Gunnison. AMAX's 32 ha (80 acre) subdivision, The Meadows, is located in the city of Gunnison and could provide up to 800 residential units; 9,290 sq m (100,000 sq ft) of professional office space; 150 motel units; and approximately 13,935 sq m (150,000 sq ft) of retail commercial space. AMAX also plans to assume development of a 121 ha (300 acre) tract of land approximately 1.6 km (1 mi) north of Gunnison which could contain a variety of residential uses and possibly a temporary construction worker housing facility. Housing development and governmental assistance programs will continue to encourage residential and commercial growth near Gunnison.

Sections 7.1.2, 7.1.3, and 7.1.4 describe some of the activities that the community and AMAX have taken to prepare for future growth and to resolve existing deficiencies in services and facilities. An unprecedented amount of lead time and pre-planning has provided all of the interested parties time to evaluate the potential impacts of population growth, and to prepare for such growth well in advance of its occurrence. A sophisticated local government and a cooperative Project proponent will allow Gunnison County to be well prepared to accommodate and to obtain maximum benefit from the population growth associated with the Mount Emmons Project.

7.1.2 AMAX GROWTH MANAGEMENT STAFF

Since 1978, AMAX has had a Community Affairs Office in Gunnison, a Community Affairs Team, and a Community Development group in its Environmental Services, Inc. subsidiary. AMAX established a Community Affairs Office in Gunnison in December 1978. The office has the following staff positions:

Resident Project Manager
Manager of Community Affairs
Assistant Manager of Community Affairs
Environmental Permit Coordinator
Communications Coordinator
Administrative Secretary/Volunteer Services Coordinator
Secretary

This office is primarily involved in governmental relations, growth management, and communications programs. The staff is experienced in state and local government planning and management. The staff manages technical and financial assistance programs and will have the responsibility for working with local leaders to identify and implement growth management programs.

In April 1979, AMAX developed a Community Affairs Team (CAT). This Team was comprised of seven consultants with experience in local government planning, architecture, housing development, government finance, human services, and growth management.

The CAT has provided technical assistance and advice to community leaders and agencies. Team members have assisted in the identification of existing problems and the assessment of new programs needed to meet growth requirements. They have also assisted AMAX in developing specific growth management programs for the Mount Emmons Project.

In June 1979, AMAX Environmental Services, Inc. created a Community Development Department. This department is responsible for the identification, development, and implementation of housing related programs for the Mount Emmons Project. Some programs are already underway, including the development of an eighty acre subdivision, The Meadows, in the city of Gunnison, and, recently, a proposed 121 ha (300 acre) parcel located immediately north of Gunnison.

7.1.3 AMAX FINANCIAL ASSISTANCE

AMAX has provided over one million dollars in direct financial assistance to the community for programs and activities designed to increase the capacity of local agencies and institutions to prepare for growth and upgrade existing services and facilities. In most instances, financial assistance has been used to leverage other funding programs. Listed below are the programs that have received AMAX financial assistance:

BMML Technical Assistance to Local Government
County Administrative Funds
County Computer System Funds
County Wide Housing Conference
County Wide Law Enforcement Training Program
County Wide Resident Survey
Crested Butte School Yard Improvements
Gunnison Assistant City Planner Matching Funds
Human Services Council Staff Matching Funds
Jail Recreation Equipment
Local Bank Deposits
Rural Communities Institute Design Conference
Senior Citizen Exercise Program
Seniors Discount Book

Stress Management Workshops for Gunnison Schools and Human Services Council
Trout Unlimited Stream Improvements in the Gunnison River
Western State College Foundation Assistance
Western State College Housing Study

In addition to the specific growth management financial assistance detailed above, AMAX has donated over $55,000 since 1978 to various community functions and organizations, such as Scouting Programs, Special Olympics activities, and civic events.

7.1.4 COMMUNITY PREPARATION FOR GROWTH

Local government and community agencies have already taken significant steps to improve existing services and facilities and to prepare for future growth. Listed below are examples of local efforts since 1978. This list is not all inclusive.

1. The city of Gunnison adopted a City Master Plan, and is revising subdivision standards.
2. The city of Gunnison financial institutions are using subsidized housing finance programs (CHFA) for the first time in their history.
3. Local financial institutions have started to use the secondary mortgage market for mortgage financing.
4. Local human services agencies founded and incorporated a Human Services Council to coordinate and improve human services delivery.
5. Gunnison County acquired a computer for land use data collection and financial management programs, and has hired a full time operator. Other local agencies have formed a computer users group.
6. Gunnison County built a new airport terminal in 1980, and completed full renovation of their courthouse the same year.
7. The city of Gunnison adopted a revised salary plan and personnel policies.
8. Multi-family housing is being constructed in the city of Gunnison and is more readily accepted as a quality housing option.
9. The Chamber of Commerce has organized a Community Development Committee.
10. Gunnison County has hired its first county engineer.
11. The city of Gunnison upgraded beginning police salaries from $650.00 to $955.00 per month, and added two officers.
12. The city of Gunnison is participating in a 201 wastewater study to analyze expansion of wastewater capacity. A similar study is also underway in the East River valley.
13. The city of Gunnison has hired a new professional city manager, a new professional engineer, an assistant engineer, and an additional code enforcement officer. Other local governments have also developed professional staffs.
14. The city of Gunnison created a planning office, and now has a planning director and assistant planner.
15. The School District has acquired land for school expansion programs, and has implemented a subdivision school fee provision with some local governments.
16. The city of Gunnison adopted a sales tax increase to help finance services and facilities.
17. A community indoor recreation center is being planned for the Gunnison area.
18. A community directory for new residents has been printed by the Human Services Council.
19. Solid waste disposal programs are being expanded to accommodate new growth.
20. Mt. Crested Butte has implemented a paving program.
21. Law enforcement agencies have developed an officers' educational program to reduce employee turnover.
22. Gunnison County has a Housing Authority which is developing low income and senior housing.
23. The town of Crested Butte residents are planning to develop a community center.
24. The County Hospital has developed a four phase expansion plan.
25. The Chamber of Commerce is initiating an industrial development program to create an industrial park.
26. The town of Crested Butte has adopted a use tax to help finance services and facilities.

The activities by the community and AMAX to prepare for growth indicate a high level of coordination and cooperation. They demonstrate both a commitment and a capacity to accommodate growth and to provide quality services and facilities.

Sections 7.1.2, 7.1.3, and 7.1.4 have described the activities that have taken place to date. Sections 7.1.5 through 7.1.6 will describe the approach that AMAX proposes to insure a successful growth management effort by all of the interested parties.

7.1.5 GROWTH MANAGEMENT PROGRAMS

AMAX growth management programs can be divided into two categories: housing programs and community services programs.

The housing programs are designed to facilitate the timely development of housing in Gunnison County. Housing programs require a cooperative effort between AMAX and private developers. Government's role in housing development is generally a planning and regulatory function and the provision of utilities.

The community services programs generally are designed to provide revenues for services and facilities necessary to accomodate new population. Some programs may be developed by the community and AMAX through a local task force described earlier in this chapter.

All of the proposed growth management programs in this chapter are based on the four assumptions described in Section 7.1.1.

7.1.5.1 Housing Programs

Housing is one of the most serious current problems in Gunnison County, with or without the development of the Mount Emmons Project. Substantial amounts of additional housing will be needed to satisfy an existing shortage, replace substandard housing, and provide housing for population growth associated with the Mount Emmons Project and "baseline" growth which is not associated with the Project.

Housing is normally provided by the private sector. Government exercises some control over housing through planning and zoning regulations, building codes, and provision of utilities. Government also is involved in some types of subsidized housing programs.

AMAX's programs are designed to encourage timely, affordable, quality housing development. The housing industry will build housing and AMAX will provide assistance or incentives to facilitate housing development.

7.1.5.2 Land Acquisition

AMAX has acquired land in and near the city of Gunnison for residential and commercial development. This land also could be used for public facilities and amenities. The acquisition of land not only provides some influence over where housing may be located, but also helps to reduce land speculation and subsequent inflation of housing prices.

AMAX has acquired a 32 ha (80 acre) parcel within the city of Gunnison and is in the process of subdividing this land for residential and commercial development. (Figure 7.1-1). This subdivision will contain approximately 800 multi-family and rental units, 9,290 sq m (100,000 sq ft) of office space, 150 motel units, and a 13,935 sq m (150,000 sq ft) shopping center. (Figure 7.1-2). AMAX is also in the process of acquiring a 121 ha (300 acre) parcel located north of Gunnison. This parcel will be subdivided and developed for a variety of low to moderate density residential uses. The total potential residential capacity of both parcels will exceed 2,000 units.

The land acquisition program will help insure that land is available for development to meet most of the needs of the increased population generated by the Mount Emmons Project. This program will complement the efforts of other developers to provide land and housing for community needs. It will provide an incentive to attract builders and developers to develop residential, commercial and industrial facilities in this area.

AMAX will encourage capable builders, developers, and investors to build the necessary facilities and provide the necessary services. Land would be sold to developers at a reasonable price or dedicated to public use. AMAX, in cooperation with the local agencies, would exercise planning and development control to ensure maximum quality and community acceptance. Efforts will be made to pass on any cost savings that may occur to the ultimate purchasers and users. None of the housing developed on this land would be limited to AMAX employees except for the temporary construction housing facility described below.

7.1.5.3 Construction Housing Facility

A full-service construction housing facility designed according to the expected construction manpower and schedule will be developed to provide housing and services for single* construction workers. For the proposed Project schedule, the facility would provide approximately 400 single rooms and an adjoining 100 pad recreational vehicle park, which would accommodate approximately 500 construction workers. It would probably be located north of the city of Gunnison on AMAX's 121 ha (300 acre) parcel.

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* Single - including those who are widowed, divorced, or who have families living outside of Gunnison County or whose families do not accompany them to Gunnison County.

The facility will be a combination of permanent and temporary structures. A cafeteria, laundry, and indoor and outdoor recreational facilities would be provided. The housing facility would be used until construction work is completed. It would be operated by a professional, experienced staff.

The development of such a facility would result in expedient and affordable housing for a large part of the construction work force. Recruitment of construction workers would be aided, problems of productivity would be reduced, and effects on the community would be reduced because fewer workers would have to use existing housing.

Once mine construction is completed, the permanent portion of the facility may be suitable for other uses (such as student or ski employee housing). A final determination on other uses of the facility will be made after the construction on the Mount Emmons Project is complete.

7.1.5.4 Mobile Home Parks

The high cost of housing indicates that mobile homes will have to supply a portion of the housing needed for future permanent and temporary County residents. The demand for additional mobile homes is projected to be approximately 1200 units by 1994. To supply a reasonable portion of this demand, AMAX will work with private interests to facilitate high-quality permanent mobile home parks. The parks will be built and operated by private developers, operators, and investors. Some or all of the land may be made available through the company's land program. The percentage of mobile homes in Gunnison County is expected to increase by only 1 percent from 24 percent now to 25 percent 14 years from now.

Mobile homes provide adequate housing with a minimum commitment of time and resources which can be purchased at a reasonable price. Some parks can be designed to be converted to permanent home sites if such conversions are desired at a later date. In order to insure that mobile homes meet the needs of the community: 1) high quality parks must be developed to provide quality living conditions; and 2) high quality efficient mobile homes must be used.

Mobile home parks are sometimes considered unattractive and undesirable. The development of high-quality parks, however, is likely to alleviate much of the existing concern. If needed to encourage such development, AMAX would provide financial guarantees to park developers. AMAX will encourage cooperation of local government to set appropriate standards to insure quality development.

7.1.5.5 Rental Housing

The rental housing program is designed to encourage the development of at least 500 rental units. They would be built by private developers and would be privately owned and operated.

Land would be made available for these units through the AMAX land program. The development of multi-family rental housing would depend on the demand for such units, and the private sector response to that demand. AMAX estimates the demand to be:

100 units during the first year of construction
200 units during the third year of construction, and
200 units during the fourth year of construction.

AMAX will work with the private sector and government to insure that rental units are attractive, reasonably priced, well managed, and properly maintained. If needed to encourage such development, AMAX would provide financial guarantees to developers.

7.1.5.6 Lot Development

Under the lot development program, up to 400 finished lots would be developed with streets, curbs, gutters, sidewalks, all utilities, and gradings for home construction. Lots would be sold to home builders or individuals for construction of owner-occupied homes. Land from the company's land program would be used. The lot development program would operate from the third year of Mount Emmons' construction through the completion of construction. The lot development program will help insure adequate sites for single-family homes. This program will occur concurrently with other developers' efforts to make a sufficient number of homesites available.

7.1.5.7 Home Purchase Assistance

The current high interest rates make it very difficult to qualify for home mortgages. If these conditions persist, AMAX will analyze alternatives for providing assistance to employees who may not be able to make adequate down payments. Such assistance may involve direct aid by the company, or assistance through existing financial institutions. Development and implementation of such a program will depend on future financing conditions.

7.1.5.8 Housing Authority Land

AMAX land may be sold at a reasonable or reduced price to the Gunnison County Housing Authority so that it can be used for housing for senior citizens or low income families. This not only provides housing opportunities for low income and elderly persons, but it also serves to relieve the heavy demand on available housing. The Gunnison County Housing Authority will continue to have primary responsibility for providing housing to low income families and senior citizens. AMAX will assist in the planning and development of this program.

7.1.5.9 Bank Deposits

In Gunnison County and in many rural areas, financing for housing and other types of urban development is not easily obtained. To help remedy this situation AMAX has established a bank deposit program. Funds are deposited in local financial institutions with the understanding that these deposits will be used for local housing and other urban developments. This program began in 1979 when a half million dollars ($500,000) was deposited with local lenders. The institutions where these funds were deposited were encouraged to provide training to their employees in mortgage financing which would be paid by the interest generated from these deposits. AMAX will also establish local bank accounts for local purchases and expenditures. AMAX currently has a direct deposit program for employee payroll.

The intent of all of the housing programs described above is to insure that adequate housing is available in a timely manner during the development and operation of the Mount Emmons Project. A number of positive programs have already been developed by the community, the housing industry, and AMAX to insure that this happens. These programs encourage the private sector to participate in this effort.

7.1.6 COMMUNITY SERVICES PROGRAMS

Successful growth management programs must be adaptive to changing conditions. One of the methods of achieving that goal would be the formation of a local task force to identify, monitor, and implement programs designed to provide community services and facilities. Whenever possible, these programs would be funded through existing tax mechanisms and existing financial resources. A share of the funds necessary for providing these services and facilities could be the prepayment of state severance taxes.

BMML's studies estimate that total local government revenues will exceed total local governmental expenditures by approximately $17 million during the fourteen year study period from 1980 to 1994. However, the town of Crested Butte revenues never exceed expenditures with or without the Project. There are also revenue shortfalls projected during the construction period. Approximately 60 percent of the future property tax base will be generated by the Mount Emmons Project, and a large share of the sales tax revenue will be generated by direct and indirect employment resulting from Mount Emmons Project development and operation. Much of the revenue generated by other tax sources, such as a use tax, will also be attributable to the Mount Emmons Project. The major challenge facing the County is the equitable and timely distribution of those revenues to meet the needs of the community.

AMAX will work with local leaders in analyzing the feasibility of a local task force, and the alternatives for the implementation and operation of such a group as well as other approaches for implementing a successful growth management program. If such a task force is created, AMAX will work with the task force members to insure that adequate staff is available to the task force. The BMML analysis indicates that sufficient governmental revenues will be available for growth to pay its own way in the long run. However, in order to insure that these estimates are adjusted to reflect actual conditions, a monitoring program will be developed in cooperation with local agencies.

This monitoring information would be used by the local task force and appropriate units of local government. The elements of such a monitoring program are described in Section 8.2

If a local task force is created, it would be responsible for both identifying needs and developing and implementing programs, and allocating the available resources to meet those needs. If the task force determines that shortfalls in basic services are occurring which are directly attributable to the development of the Mount Emmons Project, AMAX will insure that the necessary funds are available to meet the actual needs of local government identified by the monitoring process. To the extent possible, AMAX would utilize prepayment of taxes and tax credit programs to provide the funds identified by the task force to the appropriate unit of local government. AMAX will also encourage local agencies to consider revenue sharing and contracts for services between units of local government.

In addition to the adaptive process described above for identifying and addressing local government services, AMAX is committed to a number of additional programs. These programs are designed to provide expanded services which AMAX and the community agree should be provided, even though there is no determination that this need is specifically caused by Mount Emmons Project development. These programs are described below.

7.1.6.1 Technical Assistance

Local governments and businesses in Gunnison County have had some difficulty in meeting the present demands for facilities and services. Those demands will increase as the population increases. Some opportunities exist to achieve economies of scale and higher quality services as the population expands. However, there is also some potential for the level and quality of services to deteriorate if proper planning does not occur.

AMAX will provide technical assistance to help local government, community agencies, and businesses to provide adequate services and facilities for the expanding population. This technical assistance will include advice on how to identify and resolve potential problems in service delivery. It may involve some assistance in utilizing grants programs, or advice on how to make more effective use of resources. This assistance is designed to help the community use their governments, taxes, and other funding sources as efficiently as possible, and depend as little as possible on new industry to solve problems.

This technical assistance will be provided primarily by AMAX staff and the Community Affairs Team described in Section 7.1. Such assistance is being provided only in cooperation with existing agencies or institutions. AMAX will not attempt to "solve" a problem associated with inadequate services or facilities without the full cooperation of the entity or agency which is responsible for providing the service or facility.

Local efforts to provide the services, facilities and talents needed by a growing community are already underway. These are described in Section 7.1.4.

7.1.6.2 Community Assistance

The community assistance programs are designed to: (1) help assimilate newcomers into the community; and (2) avoid community disruption and conflict between newcomers and established residents.

The Human Services Council of the Gunnison Region, Inc. will coordinate a newcomer's service and establish a task force to facilitate good relations between newcomers and established residents. The AMAX Volunteer Group will assist in this effort. AMAX will continue to make Project information available in advance, including quarterly statements and projections of employment and family status. AMAX will also provide some financial assistance to this program.

AMAX will provide information on local services and agencies to new employees and their families. AMAX contractors will be asked to participate, as appropriate, in community information sessions and to cooperate with the company's effort to encourage good community communication programs.

To encourage local employment, AMAX will:

- encourage local hires using methods such as post high school and college recruitment and,

- provide some part-time job opportunities

To help residents in the community better understand mining and the employment opportunities it provides, AMAX will provide educational programs to schools and community groups.

7.1.6.3 Western State College Assistance

Western State College is an important educational institution in the Gunnison community, and AMAX desires to see that position maintained and strengthened. AMAX has and will consult with Western State College's administration to determine an appropriate Company role. AMAX is working with the city of Gunnison and the Western State College Foundation to locate the proposed Wayne Aspinall Conference Center in Gunnison. AMAX will also provide an annual donation for library acquisitions, support for campus security during the early stages of Project development, and will consider the endowment of a faculty chair. AMAX will encourage the development of professional and technical education programs. The company has benefit programs which pay tuition for employees.

7.1.6.4 Medical and Social Services Assistance

The need for medical and social services in Gunnison County will increase, requiring expanded facilities and new staff. AMAX will support comprehensive planning for medical and social services. AMAX already has worked with the Human Services Council of the Gunnison Region, Inc. and the Gunnison County Hospital in their efforts to identify needs and provide services.

7.1.6.5 Transportation

AMAX will work with the community and applicable government entities in addressing several transportation issues.

BMML's study indicates that Highway 135 requires upgrading in several places between Gunnison and Crested Butte with or without the Mount Emmons Project. AMAX will cooperate with the State Department of Highways in developing an appropriate improvement plan.

AMAX will cooperate with the State of Colorado and/or Gunnison County to construct a bypass around the town of Crested Butte to connect Highway 135 with the Kebler Pass Road and the mine.

AMAX will encourage contractors to schedule shifts to minimize conflicts with other traffic on the public roads. Weekend construction operations will be discouraged to allow workers who do not have their families with them to return home on weekends.

Car pooling will be encouraged at the Mount Emmons Project. Employees at the Henderson and Climax mines use car pools extensively for home-to-work travel. AMAX will work with the community and the private sector to analyze the feasibility of a year-round public bus system between the town of Crested Butte and the city of Gunnison. Some of the potential options for the development of such a system are:

1. Increased population may push the community past the threshold necessary to support a year-round daily bus system or an expansion of the existing Mountain Express without subsidy.

2. Local government may decide to operate a bus system itself, or provide some type of tax incentive or tax subsidy for such a system.

3. AMAX may consider a short-term subsidy which would guarantee a certain amount of fares daily. If the ridership fell below that minimum, AMAX would make up the difference in fares. At the end of the subsidy period, the system would have to become self-supporting.

4. AMAX may guarantee loans for a private company to purchase the buses necessary to operate a daily bus system. If the system proved feasible, the loans would be repaid and AMAX would be relieved of its liability.

It is premature to determine whether a bus system is feasible or to commit to any specific type of subsidy or assistance. AMAX cannot require its employees to use the bus system. However, AMAX will cooperate with the community and explore alternatives to develop a reasonable transportation system if it appears that such a system would be desirable.

7.1.6.6 Mine Closure

As currently proposed, the mine is planned to operate for at least 27 yr after production of concentrate begins. If it should become feasible to mine some lower grade portions of the deposit, the mine life might be extended for an additional 5 to 15 yr. As presently scheduled, mine closure would not occur before the year 2015.

It is difficult to predict what conditions might exist 34 years from now. Making this prediction would be analogous to trying to predict 1981 conditions 34 years ago, in 1947. Some information does exist on the closure of mines in other communities. The majority of the problems relate to the sudden closure of a mine without much advance warning and the resultant unemployment and depressed local economy. As currently proposed, the Mount Emmons Project will go through an extended phase out period lasting about five years. This will provide the community and the company ample time to plan for the eventual shut down of the mine. Much of the phase down will be accomplished through attrition and not filling vacant jobs. AMAX will work with the community to minimize the impact of this closure. It may be necessary for the community to attempt to attract replacement jobs. It may also be necessary for local government to consider setting aside some tax revenues to deal with the effects of closure. Ample lead time exists to deal with the mine closure well in advance of its occurrence.

7.2 NATURAL ENVIRONMENT

Environmental mitigation or adverse impact avoidance has been integrated into the design of the Project. This has been accomplished by qualified engineers, scientists, and planners with extensive experience in development of mining projects. Their knowledge and experience have been used to reduce adverse impacts and, where possible, enhance existing conditions.

7.2.1 PHYSICAL ENVIRONMENT

7.2.1.1 Geology/Geologic Hazards

Appropriate protective measures will be designed to minimize unavoidable adverse impacts on geology or creation of geologic hazards. AMAX will utilize proper engineering practices in locating and constructing facilities to avoid existing geologic hazard areas.

Efforts to identify geologic hazards will continue during the design and construction phases. Specific mitigation measures addressing identified potential unavoidable impacts are outlined in Table 7.2-1. These measures include slope stability protection, erosion control, rock fall protection, and others.

7.2.1.2 Avalanche Hazards

The Evans Basin mine site, ore haulage route, and mill/tailing area are in low avalanche hazard areas and, therefore, no special mitigation measures will be necessary. Since relatively long return periods exist in the vicinity of the mine access and Carbon Creek portal roads, mitigation of avalanche hazards to protect road traffic will not be necessary unless unusual avalanche conditions develop. Table 7.2-2 outlines specific mitigation measures.

The proposed Crested Butte bypass road, to be built below Gibson Ridge, will be located to avoid the possibility of avalanches reaching the road.

Although blasting vibration may, from a theoretical standpoint, release avalanches, this hypothesis has never been proven and is not borne out by experience at the Climax, Henderson, or Urad mines. Unless a cause and effect relationship can be established, it is premature to recommend any mitigation procedures.

7.2.1.3 Soils

Measures for minimizing unavoidable impacts to soil resources are closely related to the Project reclamation plan outlined in Section 7.3. Mitigation measures outlined in Table 7.2-3 will be employed as a part of the reclamation activities, which will occur throughout the life of the Project. Timing of reclamation activities is discussed in Section 7.3.

Table 7.2-1 SUMMARY OF GEOLOGY/GEOLOGICAL HAZARDS MITIGATION MEASURES FOR THE PROPOSED PROJECT

Impact	Mitigation	Anticipated Cooperating Organizations[a]
Accelerated erosion	Provide for early reclamation during construction, continuing through Project operation and final revegetation of disturbed areas after closure.	USFS, COE, CWQCD, SCS, CMLRB
	Use water bars, riprap, gabions, and other erosion controls.	
Increased slope instability and reactivation of landslides	Incorporate avoidance of unstable areas in Project design.	
	Improve drainage in areas of slope instability.	
	Maintain or decrease ground water levels where applicable.	
	Install retaining structures.	
	Remove peat and other compressible organic materials.	
Increased rockfalls	Route and locate facilities to avoid rockfall areas.	
Slope instability at tailing pond area during and after operation	Tailing will buttress slopes.	
	Improve drainage in tailing area with diversion structures.	
Tailing dam stability	Route area runoff around pond for PMF.	
	Use earth-fill dam and revegetate as soon as practical.	
	Revegetate tailing surface after Project closure.	
Subsidence	Limit access to the potential area of subsidence during operations and actual area of subsidence after Project closure.	
Disruption of natural topography and contours in areas of surface facilities	Recontour areas of disturbance to blend with surrounding area.	

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[a] Cooperating Organizations

BLM - Bureau of Land Management
CAPCD - Colorado Air Pollution Control Division
CDOH - Colorado Division of Highways
CDOW - Colorado Division of Wildlife
CMLRB - Colorado Mined Land Reclamation Board
CNAC - Colorado Natural Areas Council
COE - Corp of Engineers
CSEO - Colorado State Engineers Office
CWCB - Colorado Water Conservation Board
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Table 7.2-2 SUMMARY OF AVALANCHE HAZARD MITIGATION MEASURES FOR THE PROPOSED PROJECT

Impact	Mitigation	Anticipated Cooperating Organizations[a]
Accidental extension of active avalanche period during mine operation due to blasting and subsidence	Design and conduct avalanche forecasting program.	USFS, Mount Crested Butte Ski Area
Increased exposure of population and employees to avalanches	Location of facilities and roads in low avalanche hazard areas.	
	Use Mount Axtell tunnel for ore haulage.	
	Prohibit skiing on Mount Emmons after operations begin.	

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Table 7.2-3 SUMMARY OF SOILS MITIGATION MEASURES FOR THE PROPOSED PROJECT

Impact	Mitigation	Anticipated Cooperating Organizations[a]
Soil disruption during stripping, stockpiling, and redressing	Minimize disturbance time and areal extent of disturbed soils.	USFS, CMLRB, SCS, CWQCD, COE
	Schedule disturbance to coincide with periods when soils are dry, especially in clay soils.	
	Minimize traffic and exposure of subsoil materials during construction.	
Soil compaction	Minimize off-road traffic and soil handling.	
	Use low-ground-pressure equipment for spreading and dressing topsoil during reclamation.	
	Revegetate as soon as practicable.	
	Minimize exposure of subsoil materials during construction.	
Increased soil instability including soil creep and slumping	Stabilize unstable slopes as soon as practicable.	
	Minimize traffic on steep slopes.	

Table 7.2-3 SUMMARY OF SOILS MITIGATION MEASURES FOR THE PROPOSED PROJECT (concluded)

Impact	Mitigation	Anticipated Cooperating Organizations[a]
	Implement erosion and runoff control measures as soon as practicable.	
	Avoid cuts through unstable talus slopes.	
Soil erosion and sedimentation	Minimize slope length with contouring, ditches, or terraces.	
	Avoid prolonged exposure of soils with high erodibility factors.	
	Avoid disturbance of steep slopes.	
	Minimize disturbance to drainages where practicable.	
	Revegetate as soon as practicable.	
	Control runoff in disturbed areas with mulch, riprap, diversion structures.	
	Use riprap for stream bank stabilization.	
	Salvage soils of wet areas or drainages for redressing on similar areas.	
	Avoid excessively cobbly or bouldery areas during topsoil stripping.	
Decreased soil productivity	Minimize handling during stripping and stockpiling.	
	Utilize N-fixing legumes and soil innoculation.	
	Revegetate as soon as practical.	
Loss of agricultural, woodland, and rangeland soil productivity	Carry out reclamation plan.	

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7.2.1.4 Air Quality

Mount Emmons Project facilities will meet all Colorado Air Pollution Control Regulations and standards and the Federal Clean Air Act and standards. Specific emission source controls and mitigation measures are outlined in the Colorado Air Emissions Permits, issued to the Mount Emmons Project in February of 1981.

General controls and mitigation measures, which have been incorporated into the Project design to reduce emissions from facilities, are listed in Table 7.2-4.

Population increases will cause secondary air quality impacts due to increased vehicle emissions from traffic and increased emissions from home heating sources, especially wood burning stoves and fireplaces. Mitigation of secondary air quality impacts from increased vehicle emissions will require action by state and local government as well as individual citizens of Gunnison County. AMAX will encourage car pooling by employees and study possibilities for expanded mass transportation systems.

7.2.1.5 Water Resources

Potential alteration of ground water flows, reduction in ground water quality, alteration of surface water flows, and reduction in surface water quality in the vicinity of the mine site will require the development of mitigation measures. The following discussion expands on the mitigation measures listed in Table 7.2-5. Because of the different physical characteristics of the mine and the mill/tailing pond sites, mitigation measures for these areas are discussed separately. Additionally, mitigation measures for potential impacts to domestic water supplies are contained in Section 7.2.1.5.4.

Table 7.2-4 SUMMARY OF AIR QUALITY MITIGATION MEASURES FOR THE PROPOSED PROJECT

Impact	Mitigation	Anticipated Cooperating Organizations[a]
Point source emissions at the mill	Use scrubbers or equivalent dust collectors.	CAPCD, EPA
	Use low sulfur coal.	
	Use high efficiency lime venturi scrubber on boiler.	
	Use multi-stage feed for incinerator.	
Fugitive dust emissions at the mill/tailing site	Partially enclose or contain emergency coal storage pile, apply tackifier to surface and use only in emergency.	
	Use water sprays during scraper operations.	
	Revegetate disturbed areas as soon as practicable.	
	Pave major access roads, in-plant roads and parking lots.	
	Water and add adhesive binder on unpaved roads.	
	Provide vehicle washes and mud carryout prevention.	
	Maintain water pool on tailing pond.	
	Utilize adhesive binder stabilizer or wetting procedures on tailing beach area.	
	Revegetate tailing dam face as soon as practicable.	

Table 7.2-4 SUMMARY OF AIR QUALITY MITIGATION MEASURES FOR THE PROPOSED PROJECT (concluded)

Impact	Mitigation	Anticipated Cooperating Organizations[a]
Point source emissions within the underground mine or at the mine surface facilities	Use catalytic scrubbers on all underground diesel equipment.	
	Use water sprays at underground draw points.	
	Use dust collectors underground at loading points.	
	Natural deposition and low velocity airflow along with high humidity underground.	
	Use high efficiency lime venturi scrubber on boiler.	
	Use low sulfur coal.	
	Use scrubbers or equivalent dust collectors.	
	Use multi-stage feed for incinerator.	
Fugitive dust emissions at the mine site	Partially enclose or contain emergency coal storage pile, apply tackifier to surface and use only in emergency.	
	Use water sprays during scraper operations.	
	Pave major access roads, in-plant roads and parking lots.	
	Revegetate disturbed surfaces as soon as practicable.	
	Water and add adhesive binder to unpaved roads.	
Increase in vehicle emissions along Project access routes	Investigate use of mass transportation measures such as car or van pooling and busing of employees.	CAPCD, EPA, GCBCC
	Schedule shift changes not to coincide with ski area traffic.	
Increase in secondary emissions from population associated increases in traffic, fireplaces, construction	Support land use planning regulations. Implement air quality computer programs and, possibly, emission control regulations.	GCBCC, City of Gunnison, Town of Crested Butte

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Table 7.2-5 SUMMARY OF WATER RESOURCE MITIGATION MEASURES FOR THE PROPOSED PROJECT

Impact	Mitigation	Anticipated Cooperating Organizations[a]
Decreased surface water quality	Operate with no discharge of process water.	USFS, CWQCD, EPA, CMLRB, CWCB, COE, Town of Crested Butte
	Locate milling facilities so that any spills are tributary to the tailing pond.	
	Revegetate disturbed areas as quickly as practical. Grade roads and minimize vehicle traffic, particularly during spring snow melt. Intercept and divert erosion sediment into settling basins. Work in stream channels only during periods of low flow. Construct culverts to divert runoff to natural drainages. Route surface runoff away from construction areas. Utilize water bars, riprap, gabions and other erosion controls.	
	Maintain graded roads and runoff channels and culverts.	
	Control fugitive dust emissions.	
	Dike all oil, diesel fuel, and similar storage areas; establish emergency contingency program for accidental spills; utilize oil skimmers and separators on settling ponds.	
	Pipe mine water to mill and/or treat at heavy metals water treatment plant before discharge.	
	Treat domestic wastes from mill and discharge to tailing pond.	
	Dispose of waste sludges at designated sites.	
	Provide tertiary treatment of domestic wastes before discharge and an acceptable method of sludge disposal at the mine site.	
Surface-water flow changes	Minimize disturbed areas and revegetate as soon as practical.	
	Obtain mill make-up water from large flow sources during spring runoff periods, if possible. Divert water during other periods when water is physically legally available. Recycle treated waters for reuse.	
	Intercept surface flows above, divert around, and discharge downstream of tailing pond.	
Decreased ground water quality	Construct tailing dam with impervious core to prevent seepage into surficial geologic units.	
	Underlying bedrock of tailing area has very low permeability and dips to the west. Natural mitigation will occur by neutralization	

Table 7.2-5 SUMMARY OF WATER RESOURCE MITIGATION MEASURES FOR THE PROPOSED PROJECT (concluded)

Impact	Mitigation	Anticipated Cooperating Organizations[a]
	of acidic waters and the absorption of heavy metal ions from solution by surficial materials and bedrock. Employ controlled management of ground water, minimizing flow through mobilized zones and the mine-extraction area. Combine favorable aspects of such mitigation techniques as: 1) adit seals with grouting of faults; 2) slurry discharge/inject into the rubble; 3) decant system with drains and new technology.	
Potential disruption to town of Crested Butte domestic water supply.	In cooperation with the town of Crested Butte, relocate and improve water supply by moving source to Slate River and constructing well system.	

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7.2.1.5.1 Mine Site Area Ground Water Mitigation. Because of the complexity of impacts related to ground water due to mining activities, several potential mitigation measures are presented. These alternatives address the expected impact on ground water quality at the mine site and represent the best current available technology. As mining progresses, and more information about the geology and advances in technology are developed, improved mitigation measures will be developed and employed. At this time it is premature to select the most appropriate method or combination of methods without the benefit of additional geologic information that can be gained as a result of mine development. Alternative mitigation measures considered in detail include:

1. Treatment of Mine Discharge
2. Mine Adit Seals with Grouting of Faults
3. Slurry Discharged on or Injected into the Subsidence Zone of the Mine
4. Decant System with Drains in the Mine
5. Combinations of the above

Treatment of Mine Discharge. In this alternative no control techniques would be applied to the mine workings or subsidence zone after cessation of production. The quality of the mine discharge water will depend upon the mineralogy of the fracture faces within the subsidence zone. The quantity of flow would be dependent on climatological conditions.

Studies have shown that rock from Mount Emmons is alkaline in character (Rinehart 1979a and 1980a,b) and could buffer the acid produced from the oxidation of pyrite. However, because pyrite is exposed in many of the veins and many fractures are expected to occur along veins, the available buffering capability would be insufficient. Thus, mine discharge water would require treatment for as long as necessary to comply with Colorado and federal discharge requirements.

Mine Adit Seals With Grouting of Faults. Controlling ground water storage by raising the water table in the subsidence zone would submerge a large percentage of the pyrite. Submergence would decrease the rate of pyrite oxidation because the principal source of oxygen available would be only that dissolved in the water. Ground water control would be achieved by sealing the mine and fracture conduits that are expected to carry the greatest flows. Concrete seals would be placed in mine adits (passages) and the seals would be grouted to the adit walls. Fractures and veins near the adits also would be grouted. Extensive lengths of concrete seals in the adits combined with grouting may raise the bedrock water table an estimated 244 to 305 m (800 to 1,000 ft) in the subsided area. The amount of leakage around the seals would be dependent upon the head which would develop. Snow (1980), in his "Zone II" configuration of seals, estimates the leakage to be about 2687 lpm (710 gpm).

Even though much of the subsided zone would be submerged, pyrite would still oxidize above the water table. Water passing through this area could develop a low pH and contain trace metal concentrations. Water discharging from the mine may benefit from natural buffering by the surrounding rock. The extent of treatment that this water would require is unknown at this time.

Slurry Discharged on and Injected into the Rubble Zone of the Mine. An alkaline slurry discharged over and injected into the rubblized material might prevent acid formation. In addition, fine-grained particles of the slurry could settle into the voids in the rubble and decrease its permeability. The resulting permeability might be as small as 10^{-7} cm/sec (10^{-8} ft/sec); (Snow 1980).

Pumping the slurry into the subsidence zone would be initiated after mining ceased. Hence, there would be no potential danger to miners. To insure that the lowest portions of the rubblized zone would be adequately sealed, additional slurry could be injected behind bulkheads in the mine. The depth of slurry penetration would be a function of slurry properties and the size of void spaces in the subsidence zone.

Decant System With Drains in the Mine. A decant system and gravity-fed drains would minimize the contact between seeping water and the pyrite-rich areas of the rubblized zone. This approach is based upon the theory that the water quality would deteriorate as a function of exposure to the oxidized pyrite and that less water would be exposed to pyrite with development of an effective drainage system.

The drains would consist of holes drilled into the rock outside of the subsidence zone and open at the bottom to a collection system in the mine. By testing the quality of water collected at various elevations in the drains, the areas producing the best quality water could be identified and used for well screen locations when these holes are cased. Density of the drain wells would be determined by drawdown characteristics and radius-of-influence expectations.

A decant system would be designed to collect water from depressions on the land surface in the subsided area and discharge the water into an area that would cause minimal recharge into the subsided area. This would lessen the amount of water that would be collected by the drains. The decant and drain alternative would not prevent all seepage through the rubblized zone. This alternative would work best when used in conjunction with another mitigation measure.

Combination of Mitigation Measures. An effective mitigation measure in controlling seepage through the oxidized portion of the rubblized zone may combine favorable aspects of several of the alternatives previously described. For example, a combination of Snow's (1980) "Zone II" seals with slurry in the rubble might reduce the estimated leakage to 1703 lpm (450 gpm). Restoration of the water table in Mount Emmons theoretically would result in restoration of water quality. Whether sealing, flooding, slurry or decant mitigation will be the primary mode selected will depend upon conclusions from further study and new technological developments.

7.2.1.5.2 Other Water Resource Impact Mitigation Measures. The treatment (Figure 7.2-1a) of the discharge from the Keystone Mine will cause the quality of water in Coal Creek to improve noticeably. This effort will mitigate some of the impacts of previous mining in the area. Mitigation of sedimentation impacts will include grading and paving procedures and revegetating disturbed areas as soon as practicable.

Regrading and revegetation of disturbed areas, and reconstruction of disturbed drainage divides as near as practical to their original location will mitigate impacts to surface water flow. Water for consumption will most likely be taken from sources with large flows during spring runoff periods and during other times, when physically and legally available.

7.2.1.5.3 Tailing Area Ground Water Impact Mitigation. Potential impacts from the mill area will be reduced by building a water-tight earth-filled tailing dam with an impervious core to bedrock. The ground water below the dam will be monitored. The high acid-absorbing capability of the Mancos Shale bedrock combined with a low permeability will provide natural mitigation of tailing seepage.

Because of the natural conditions existing at this location and the water-tight structure to contain process water, no impacts to surface or ground water are contemplated in the short-term or long-term (Section 5.4.2.4.5).

7.2.1.5.4 Domestic Water. Water supplies in Gunnison County are adequate for additional population associated with any production rate alternative (BMML 1980). The treatment requirements for water under current conditions are minimal and new users will be charged fees which will cover the cost of expanding the supply systems.

The only system with some existing water quality problems is the town of Crested Butte system.

Crested Butte's water supply system for many years has had to deal with high turbidity caused by runoff from snow melt and rain storms, occasional water quality problems, and freezing during the winter. Because of increased recreational and development pressures in the Coal Creek drainage, positive effects would result from development of alternative water supply sources which exist in the Crested Butte area.

Although the potential for effects on the town of Crested Butte's water supply by mine development is remote, AMAX proposes to mitigate existing and potential domestic supply problems by offering opportunities for relocating the Town's water supply source.

7.2.2 BIOLOGICAL ENVIRONMENT

7.2.2.1 Vegetation

Implementation of mitigating measures for vegetation is tied closely to the overall reclamation plan outlined in Section 7.3. Areas of vegetation disturbance will be minimized by design and on-the-ground control during the construction period. Disturbed areas will be revegetated as soon as practicable following construction or completion of operations. Disturbance to sensitive alpine and subalpine habitats will be minimized.

Although no direct impacts to the Keystone Iron Bog or sundew population will occur, management of water flow and quality into the bog area will be continued and coordinated with interested agencies and organizations. A long-range management plan for the Keystone Iron Bog area will be developed.

Land that has been purchased for exchange purposes will convey at least 134 ha (331 acres) of wetlands to federal ownership. Freshwater reservoirs left after Project closure will provide aquatic habitat and riparian areas for wildlife use. Specific mitigation measures are listed in Table 7.2-6.

7.2.2.2 Wildlife and Big Game

Mitigation measures for wildlife and big game are related closely to those for vegetation and to Project reclamation by minimizing disturbed areas and early

Table 7.2-6 SUMMARY OF VEGETATION MITIGATION MEASURES FOR THE PROPOSED PROJECT

Impact	Mitigation	Anticipated Cooperating Organizations[a]
Keystone Iron Bog - potential drying of springs	Monitor spring flows and water quality. Create hydrostatic head within faults by pumping water from the old Keystone Mine or the Mount Emmons Mine into the faults which feed springs to maintain present water quantity and quality.	USFS, COE, CMLRB, RMBL, WSC, TNC, CNAC
	Conduct transplant viability study to determine whether seeding or transplanting sundews into bogs of similar characteristics is viable.	
Vegetation destruction and alteration	Minimize disturbance areas through design and on-the-ground control.	
	Revegetate disturbances as quickly as practical with the vegetation types disturbed.	
	Use natural vegetation forms in construction.	
	Cut and clear using natural vegetation "lines" and clear only for direct needs of construction.	
	Minimize disturbance in sensitive Alpine-Subalpine habitats.	
	Monitor molybdenum levels in plant tissues and soils near the mine, mill, and ore haulage corridor.	

Table 7.2-6 SUMMARY OF VEGETATION MITIGATION MEASURES FOR THE PROPOSED PROJECT (concluded)

Impact	Mitigation	Anticipated Cooperating Organizations[a]
Loss or disturbance of riparian and wetland vegetation	Purchase existing wetlands of similar or better quality for management as wetlands by state or federal agencies or such organizations as the Nature Conservancy. Land that has been purchased for exchange with the U.S. Forest Service contains at least 331 acres of wetlands. Leave freshwater reservoirs following Project closure.	
Decreased productivity due to dust	Use dust controls (water, petrocohesives) on exposed gravel roads, tailing beach areas, etc. Pave major access roads, in-plant roads, and parking lots. Maintain water pool on tailing pond.	

[a] Cooperating Organizations

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revegetation. Many measures will be specified in management programs to be developed by AMAX in cooperation with appropriate agencies such as the Colorado Division of Wildlife (CDOW) and the U.S. Forest Service.

Lands purchased for exchange contain wildlife and big game values. Approximately 745 ha (1,840 acres) of big game winter range in Gunnison County will be put into federal ownership with the exchange. Section 5.3.6 gives additional details of the wildlife values associated with the offered lands in the exchange.

The aspen "fingers" on Red Mountain will be maintained to serve as an elk migration route. Use of the electric railroad is a mitigation measure in itself, since it does not impede big game movements. Access roads will be unfenced, or fenced with low stock fences, to allow big game movements. Construction activities in elk calving areas will be minimized during the calving period. Construction blasting will be limited to daytime hours. Off road vehicle use on AMAX properties will be restricted as will the use of firearms. In cooperation with appropriate agencies, limited access to public land through AMAX properties will be permitted.

Additional mitigation measures are shown in Tables 7.2-7 and 7.2-8.

7.2.2.3 Aquatic Ecology

Mitigation measures for aquatic ecology (Table 7.2-9) are closely related to those for water quality discussed in Section 7.2.1.5. Treatment of the Keystone Mine discharge will greatly assist in improving the water quality of lower Coal Creek and the Slate River.

The Project will use closed circuit systems for process water. The only water consumed will be that water absorbed in the tailing and concentrate and lost through evaporation and seepage. There will be no discharge of water from the mill and tailing facilities. All oil, diesel fuel, and other operational materials will be diked to prevent and minimize impacts of spills. Erosion controls will be utilized during the construction period.

Table 7.2-7 SUMMARY OF WILDLIFE MITIGATION MEASURES FOR THE PROPOSED PROJECT

Impact	Mitigation	Anticipated Cooperating Organizations[a]
Habitat destruction and alteration	Minimize land area disturbed for construction, particularly important habitats.	CDOW, USFS, RMBL, TNC, USFWS, CMLRB, GCBCC
	Leave areas of natural habitat in and around facilities where practicable.	
	Design facilities and construction activities around riparian, wetland areas, and aspen stands where practicable.	
	Develop springs and ponds on lands not being used for construction and plant with willows and cottonwoods.	
	Consider creation or reconstruction of aspen woodlands and riparian or wetland areas.	
Increased population will place increased pressure on existing habitats in Project area and the County to a lesser degree	Cooperate with local, state, and federal agencies and organizations such as the Nature Conservancy to protect or acquire habitats of special importance or high sensitivity (e.g., critical winter range, Sage Grouse breeding grounds, colonial bird nesting sites, riparian habitat, etc.). Consider important wildlife habitats in land purchases for trade (aspen woodlands, riparian areas, wetlands, winter range and alpine areas).	
	Restrict ORV use on other than maintained roads on AMAX properties.	
Potential contamination of adjacent habitats	Keep ore moist, if practical, when in the open to prevent fugitive dust.	
	Monitor molybdenum levels in soils and vegetation in adjacent habitats.	
	Utilize water erosion and dust controls.	
	Dike all oil, diesel fuel, and similar storage areas.	
Mobile species will be displaced into adjacent habitats which may cause increased stress to habitats and populations resident to those habitats. Species displacement also may change species composition, diversity, and abundance in adjacent habitats	Increase productivity, food, and cover value in habitats adjacent to construction areas. Habitat manipulation techniques, including planting of high value food species and fertilization, may be employed.	
Increased noise (particularly blasting), fugitive dust, and human presence may disrupt	Reduce blasting to the extent practical during crucial periods such as night, dawn, and dusk; during May and June for calving areas; and	

Table 7.2-7 SUMMARY OF WILDLIFE MITIGATION MEASURES FOR THE PROPOSED PROJECT (concluded)

Impact	Mitigation	Anticipated Cooperating Organizations[a]
critical lifecycles such as breeding, nesting, brooding, roosting, young-rearing, migrations, predator-prey relationships, etc.	December through March on big game winter range areas.	
	Insofar as practicable, conduct blasting activities at same time (daily or weekly) to allow animals to adapt to a more regular schedule.	
	Control fugitive dust.	
	Discourage off-road travel in habitats adjacent to construction activities during the main bird breeding/nesting period of mid-May through mid-June.	
	Conduct educational programs to sensitize employees to the need for minimizing disturbance.	
	Cooperate with and encourage the CDOW and U.S. Forest Service in developing and implementing a comprehensive wildlife management and access program.	
Increased presence of humans will increase pressure on huntable species, increase the risk of vehicle-wildlife collisions, increase the chance of human-wildlife conflicts, increase the incidence of collecting (reptiles, amphibians, bird nests, etc.) by humans. Increase in domestic pets (cats and dogs) will increase the likelihood of wildlife being killed or harassed.	Encourage an increase in enforcement personnel by CDOW and USFS.	
	Cooperate with and assist the CDOW and U.S Forest Service in implementing public awareness programs to: (1) the sensitivity of wildlife; (2) warn the public of disease potential, particularly concerning rodents; and (3) warn the public against feeding wildlife, leaving refuse in the open, and approaching wildlife for observation. Wildlife informational warning signs will be posted on AMAX property.	
	Collecting of any wildlife will be prohibited on AMAX property.	
	The County will be encouraged to implement and enforce a strict leash law or control ordinance for domestic pets.	
	Firearms will be prohibited on AMAX property except under special permit.	

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Table 7.2-8 SUMMARY OF BIG GAME MITIGATION MEASURES FOR THE PROPOSED PROJECT

Impact	Mitigation	Anticipated Cooperating Organizations[a]
Impacts on big game habitat, populations, and life cycles from construction, operation, and increased direct and indirect human activity.	(Most mitigation is similar to preceding wildlife mitigations.)	USFS, CDOW, BLM, USFWS
	Purchase of winter range areas on private lands for trade to agencies, the Nature Conservancy, or to manage as winter range.	
	Increase productivity of existing winter range areas through fertilization and/or range improvement programs.	
	Assist CDOW in emergency winter feeding programs should the need arise.	
	Railroad and access roads will be unfenced or, at most, fenced only with low stock fences.	
	Restrict activities in calving areas during late-May to mid-June.	
	Restrict blasting to a regular daylight schedule.	
	Maintain aspen "fingers" used as movement routes.	
	Minimized disturbance areas.	
	Natural vegetation in lower Alkali Creek streambed will be maintained where practicable.	
	When and where practicable, activities will be reduced during periods of darkness in May, November, and early December.	
	Design access roads for good visibility and post low speed limits.	
	Employee training programs will include information relative to wildlife laws, regulations, and management programs, location of road kill areas, need for wintering animals to be undisturbed.	
	Design shift changes away from periods of dawn and dusk when practical.	
	Cooperate with the CDOW and U.S. Forest Service in designing and implementing a site specific big game and wildlife management plan.	
	Support wildlife research programs and projects.	
	Increase security patrols on AMAX property during movement period and hunting seasons.	

Table 7.2-8 SUMMARY OF BIG GAME MITIGATION MEASURES FOR THE PROPOSED PROJECT (concluded)

Impact	Mitigation	Anticipated Cooperating Organizations[a]
	Restrict or control use of firearms on AMAX property.	
	Control access onto or through AMAX properties to public lands in accordance with safety requirements and recommendations of CDOW and U.S. Forest Service.	
	With Colorado Highway Department approval, improve and widen Colorado Highway 135 from Almont to Jack's Cabin cutoff road.	CDOH
	Reduce speed limits along high risk stretches during period when risk is highest (usually winter or winter range areas). Post high visibility warnings near known crossings.	CDOH, GCBCC

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Where practical, AMAX will consider opening it's owned properties to public fishing, and to undertake stream improvement projects in cooperation with the Colorado Division of Wildlife and Trout Unlimited. Stream restoration and enhancement on the Gunnison River above Blue Mesa Reservoir was completed in 1980 by Trout Unlimited using funds provided by AMAX. Freshwater reservoirs will be left to provide aquatic habitat.

7.2.2.4 Threatened and Endangered Species, Ecologically Sensitive Areas, and Areas of Special Interest

While measures designed to minimize adverse impacts to vegetation, wildlife and big game resources also minimize impacts on threatened and endangered species and sensitive ecological areas, the mitigation strategies discussed in Table 7.2-10 are directed toward specific measures affecting those species and areas. For the most part, these mitigation measures will require the cooperation of regulatory agencies in developing management and protection plans. Some land that has been purchased for exchange purposes contains values associated with ecologically sensitive areas and the potential for assisting threatened or endangered species. Section 5.3.6 gives additional details.

7.2.2.5 Wetlands

Mitigation measures for wetlands are an integral part of the proposed forest exchange as indicated in Section 5.3.6. The consumption of 45 ha (111 acres) of natural wetlands by the Project will be offset by placing 134 ha (331 acres) of wetland into the public domain, thus producing a positive benefit to the public and allowing for greater species and habitat diversity. In addition, the Project will create three reservoirs, which will remain intact after closure, providing wildlife and aquatic habitat.

7.2.3 CULTURAL ENVIRONMENT

7.2.3.1 Heritage Resources

There are a variety of methods available to mitigate unavoidable impacts to heritage resources (Table 7.2-11). AMAX will work in cooperation with the appropriate local, Colorado, and federal agencies to develop a suitable mitigation plan for each site directly impacted. The general approach will include

(1) partial excavation, surface collection, mapping, and analysis of archaeological sites that are significant or potentially eligible for the National Register, (2) a detailed architectural recording plan for sites that have standing buildings, and (3) historical research for sites which are significant or potentially eligible for the National Register.

The management of any cultural properties that lie within the indirect impact areas of the Mount

continued on 7-28

Table 7.2-9 SUMMARY OF AQUATIC ECOLOGY MITIGATION MEASURES FOR THE PROPOSED PROJECT

Impact	Mitigation	Anticipated Cooperating Organizations[a]
Habitat alteration including stream bank disruption and increased sedimentation during construction-causing temporary reduction in spawning success and reduction in habitat of fish food, especially benthic invertebrates	(Most mitigations are similar to preceding water resource mitigations.) Design and construct roads and stream crossings to minimize encroachment into stream channel and so as to not block fish movement. Minimize erosion and utilize erosion controls during construction; time construction to avoid, where practical, activities during spawning seasons.	CDOW, USFS, COE, CWQCD, RMBL, TU
Increased fishing pressure due to population increases	Treatment of Keystone Mine water will enhance the opportunity to improve Coal Creek and Slate River water quality. Restore and enhance lower Coal Creek fishery habitat. Participate with Trout Unlimited in stream improvement projects in the area. Open AMAX properties to public fishing in coordination with CDOW programs and cooperation with Trout Unlimited.	
Increased nutrient and suspended soils loading to streams as a result of increases in discharge from public domestic waste treatment facilities	Encourage compliance with standards and increase capacity of public waste water treatment facilities. Encourage regional 201 waste water studies.	
Pollution of receiving streams from accidental spills of oil, diesel fuel, or other supplies	Establish emergency contingency program for accidental spills; dike all oil, diesel fuel, and similar storage areas.	

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Table 7.2-10 SUMMARY OF THREATENED AND ENDANGERED SPECIES AND ECOLOGICALLY SENSITIVE AREAS MITIGATION MEASURES FOR THE PROPOSED PROJECT

Impact	Mitigation	Anticipated Cooperating Organizations[a]
Noise intrusions during construction of Alkali Basin facilities could cause minor disturbance of eagles roosting along East River	Minimize blasting during late evening and night when wintering eagles are present.	USFWS, USFS, CDOW, RMBL, TNC, WSC
Increased housing development in cottonwood bottom and roost areas and increased disturbance by humans	Implement employee awareness programs.	
	Cooperate with CDOW and the U.S. Forest Service in protecting area from unnecessary human intrusion.	
Increased human presence in the iron bog for research purposes, curiousity, or collection of unusual plant species	Protect the bog from disturbance by equipment.	
	Minimize dust through watering, petrocohesions or other techniques.	
	Pave mine access road.	
	Control human access and presence in bog.	
	Work with U.S. Forest Service and RMBL to limit research and intrusive activities and implement a bog protection and management plan.	
Increased potential for reduction of water quantity and quality in the iron bog	Design and implement, if necessary, a contingency plan to continue the existing levels of water quantity and quality through a pipe to fault system.	
Increased human populations may increase pressure on remote areas and sensitive areas such as alpine systems, research sites, etc. Activities such as birdwatching and wildlife photography will increase, causing possible alterations in life cycles of such species as cranes, eagles, Sage Grouse (on the leks), etc.	Initiate research to locate unusual species populations and habitats on potential development areas. Cooperate with agencies and research institutions in protecting known threatened or endangered species locations. Cooperate in possible reintroduction programs or recovery.	
	Cooperation with CDOW and U.S. Forest Service to design public awareness programs relative to laws, regulations, ecological sensitivity of certain areas, and area research programs and sites.	
	Assist RMBL in developing and implementing research site protection plans.	
Impacts related to increased human population, housing-service developments, birdwatchers, photographers may have impact on Sage Grouse leks. Ohio Creek leks are on private land which could be developed for housing.	Cooperate with Gunnison County and CDOW to protect lek areas based on CDOW management plans.	
	Consider lek areas when purchasing lands for trade.	
	Attempt to create new leks on public lands on south and west sides of Flat Top.	

Table 7.2-10 SUMMARY OF THREATENED AND ENDANGERED SPECIES AND ECOLOGICALLY SENSITIVE AREAS MITIGATION MEASURES FOR THE PROPOSED PROJECT (concluded)

Impact	Mitigation	Anticipated Cooperating Organizations[a]
Potential water quality impacts to the Roaring Judy Trout Hatchery	Subsurface strata dip to the west away from the hatchery. Ground water will accordingly move westward. Dams will be keyed into bedrock with grout curtains through shallow surficial materials. Natural run-off will be routed around the tailing system. State-of-the-art erosion control, settling basins, and reclamation will be applied to minimize potential for sedimentation.	
Impacts related to activities in wetland areas i.e., tailing disposal, facilities construction	Place wetlands into public domain via forest exchange. Develop reservoirs for the aquatic/wildlife habitat and recreation.	

Table 7.2-11 SUMMARY OF HERITAGE RESOURCES MITIGATION MEASURES FOR THE PROPOSED PROJECT

Impact	Mitigation	Anticipated Cooperating Organizations[a]
National Register Eligible Sites - aboriginal - which will be directly disturbed	Total surface collection and partial or complete excavation of the site and analysis of the contents.	USFS, BLM, SHPO
National Register Eligible Sites - Euro-American - which will be directly disturbed	Buildings with standing architecture will be mapped, sketched, photographed, and a history conducted.	
	Partial excavation of ancillary trash deposits.	
Sites that will not be disturbed	Avoid site disturbance. Protect National Register Eligible sites through security patrols, fencing, etc.	
Unauthorized collection of artifacts and site vandalism	Conduct awareness program relative to significance of heritage resources and laws and regulations governing site protection.	
Indirect heritage resources	Encourage owners to record and protect structures and sites.	

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Table 7.2-12 SUMMARY OF NOISE MITIGATION MEASURES FOR THE PROPOSED PROJECT

Impact	Mitigation	Anticipated Cooperating Organizations[a]
General construction noise	If practical, confine surface construction to daytime hours.	EPA, USFS, GCBCC
Diesel engine noise	Ensure that all diesel equipment has operational exhaust mufflers.	
Blasting noise	Perform sonic tests to ensure atmospheric conditions are suitable for surface blasting.	
	Limit surface blasting to daytime hours.	
Operational mine site noise	General activity - ensure operational mufflers on all above ground diesel equipment.	
	Ventiliation system - reduce intake and exhaust fan noise by use of specially designed housings.	
	On-site vehicle noise - enforce maximum on-site speed limits.	
Operational mill/tailing area noise	Crushing facilities - use noise silencers on building ventilation systems.	
	Dust collection system - use noise silencers for noise from dust collectors.	
	On-site vehicle noise - enforce maximum on-site speed limit.	
Operational ore haulage system noise	Wheel/rail noise - perform regular wheel and rail maintenance to avoid wheel flats.	
	Avoid routine use of locomotive horns or whistles, except where required by government regulation.	
Vehicle noise at specific residences	Consider road realignment, use of earth berm barriers, and depressed roadways during road improvements.	
Vehicle noise in the community	Encourage car pooling and restrict truck deliveries to daytime hours, if necessary.	

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Emmons Project is more difficult. The majority of the land and therefore most of the heritage resources within the indirect impact areas is in private ownership. For this reason, the voluntary cooperation of the owners of heritage resources will be sought and encouraged in an effort to record and protect those resources.

7.2.3.2 Noise

Noise will be controlled at the source by design as far as practicable. Measurements of noise at mining and milling operations similar to the proposed Mount Emmons Project have demonstrated that there will be no impact on residential areas near the Project. Table 7.2-12 outlines measures that will be employed where appropriate during construction and operation to minimize noise impacts. Surface blasting will be controlled and sonic tests utilized to ensure that atmospheric conditions are suitable to minimize blasting noise and richochets. The Crested Butte bypass road will minimize noise impacts from traffic on the Town.

7.2.3.3 Visual Resources

The most important measure which will be employed to mitigate impacts upon visual resources for any of the proposed activities is that of proper engineering and design (architecture, scale, color, and siting of facilities). Existing landform and vegetation will be employed to complement or screen activities. Reclamation following construction and cessation of operations will reduce visual impacts. Table 7.2-13 lists more specific mitigative measures for visual resources. Most facilities will be located in areas away from major public view areas. The mill site was moved to be less visible from Colorado Highway 135 and the Ohio Creek Road.

Table 7.2-13 SUMMARY OF VISUAL RESOURCE MITIGATION MEASURES FOR THE PROPOSED PROJECT

Impact	Mitigation	Anticipated Cooperating Organizations[a]
Visual quality of the facility sites and Project area will be changed	Follow existing vegetative patterns when clearing areas (i.e., do not create linear or rectangular openings); retain natural topographic features where practical.	USFS, GCBCC
	Retain as many stands of existing vegetation as practical; site facilities to fit existing vegetation openings instead of creating new ones; fit parking lots, storage areas, and buildings into vegetation where practical.	
	Place major parking lots and equipment storage areas behind screening berms, vegetation, or buildings; retain patches of shrubs and trees throughout these lots and areas.	
	Revegetate all areas as soon as practicable with species native or adapted to the particular plant community disturbed. Do not plant species which may conflict structurally with the existing plant community (e.g., trees into sagebrush areas, etc.).	
	Develop berms where practicable as extensions of natural topography, and revegetate berms with compatible species.	
	Design (color and shape) facilities to be compatible and blend with existing landscape, where practicable.	
	Control emissions and fugitive dust.	

Table 7.2-13 SUMMARY OF VISUAL RESOURCE MITIGATION MEASURES FOR THE PROPOSED PROJECT (concluded)

Impact	Mitigation	Anticipated Cooperating Organizations[a]
	Limit nighttime lighting to what is necessary.	
	Retain cottonwoods along Colorado Highway 135 to screen the site from view; reduce clearing of aspen to minimum. Preserve the aspen fingers on the south side of Red Mountain.	
	Minimize number of roads; attempt to apply more than one use to access roads.	
	Use fill materials (at least the surface of the fill) that are of a color similar to the local materials as much as practicable.	
	Use natural landform and vegetation to screen roads where applicable.	
	Design overhead power structures for the ore haulage railroad to be compatible with local landscape, if practicable.	
	Dismantle unnecessary structures following operations.	
	Construct all roads and railroads to follow the contour of the land as much as practicable.	

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CMLRB - Colorado Mined Land Reclamation Board
CNAC - Colorado Natural Areas Council
COE - Corp of Engineers
CSEO - Colorado State Engineers Office
CWCB - Colorado Water Conservation Board
CWQCD - Colorado Water Quality Control Division
EPA - Environmental Protection Agency
GCBCC - Gunnison County Board of County Commissioners
RMBL - Rocky Mountain Biological Laboratory
SCS - Soil Conservation Service
SHPO - State Historic Preservation Officer
TNC - The Nature Conservancy
TU - Trout Unlimited
USBM - U.S. Bureau of Mines
USFS - U.S. Forest Service
USFWS - U.S. Fish and Wildlife Service
WSC - Western State College

7.3 SURFACE RECLAMATION

Section 7.3 is divided into two parts: "Disturbance of Surface Lands" and "Reclamation Plan." An overview and comparison of the surface disturbances is presented to put the Project in perspective before describing the Reclamation Plan. Although the final engineering design for the Project has not been carried out, the overall reclamation commitment, approach, and methods will not be significantly affected by final engineering design. Aspects of reclamation which might be subject to adjustment by final engineering are the exact locations of facilities, steepness of slopes, and the size of specific disturbances. Acreages shown in Table 7.3-1 are estimates based on present engineering plans.

7.3.1 DISTURBANCE OF SURFACE LANDS

Surface disturbances will occur on several general sites: Mine Site, Keystone Mine Site, Ore Haulage Railway, Mill Site, Tailing Deposition Site, Reservoirs, Sand and Gravel Areas, Subsidence, and Buffer Zones. The estimated acreages of the areas to be disturbed and the areas to be reclaimed for these site groups and their subdivisions are presented in Table 7.3-1.

Table 7.3-1 ACREAGES OF SURFACE DISTURBANCE SITE GROUPS AND AREAS TO BE RECLAIMED

Site	Estimated Acreage to be Disturbed[a]	Estimated Acreage to be Reclaimed[a]
Mine Site		
Mine yard slopes	53	53
Mine yard	74	74
Mine topsoil stockpile	11	11
Mine access road	75[b]	53
Crested Butte bypass road	16	9
	229	200
Keystone Mine		
Tailing ponds	54	54
Old mill site and heavy metals water treatment plant	40	40
Upper Mount Emmons roads	36[d]	36
	130	130
Ore Haulage Railway		
Railroad bed	26	26
Railroad slopes	77	77
Railroad construction and maintenance roads	117[b]	117
Portal areas and associated contractors' yards	60	60
Portal area slopes	14	14
Coal Creek fill	39	39
Ore haulage topsoil stockpiles	4	4
Relocated Kebler Pass Road	25[b]	20
Carbon Creek Road improvement	61	39
	423	396
Mill Site		
Mill yard slopes	12	12
Mill yard	67	67
Mill topsoil stockpile	7	7
Mill access road	219[b]	184
	305	270
Tailing Deposition Site		
Tailing pond surface	985	985
Tailing dam face	55	55
Tailing interceptor conduit	84[d]	84
Tailing delivery line	32[d]	32
Tailing topsoil storage	81	81
	1,237	1,237
Reservoirs		
Carbon Creek potable water reservoir	13	0
Alkali mill makeup water reservoir	50	0
Elk Creek reservoir	23	0
Carbon Creek reservoir dam face	11	11
Alkali reservoir dam face	14	14
Elk Creek reservoir dam face	20	20
Reservoir and pumphouse access roads	29[c]	18
	160	63
Sand and Gravel Areas	200	200
Subsidence		
Estimated actual subsidence	434	0
Potential zone of influence	(917)	0
Buffer Zones		
Areas on the perimeter of and between disturbed sites	1,000	1,000
Total Approx.	4,118	3,496

[a] Area size determined by planimetry except where noted.
[b] Area size calculated using 250 ft mean disturbance width.
[c] Area size calculated using 100 ft mean disturbance width.
[d] Area size calculated using 75 ft mean disturbance width.

Some of the disturbances such as public road improvement and subsidence are not regulated by the State Mined Land Reclamation Act. Cuts and fills along public roads will be reclaimed, while the roadbed will be left in the improved state. Other disturbances such as reservoir surfaces and some access roads will also remain following final reclamation. No practical method exists for reclamation of the subsidence zone.

7.3.1.1 Mine Site

Disturbances at the mine site area will occupy 93 ha (229 acres) and will consist primarily of the mine yard, the attendant cuts and fills, the runoff control dams, and the mine access road. Much of the fill used in bench construction will be development rock. The mine access road will be paved and will be permanent to allow access for inspection. The Standard Mine Road will be intercepted by the cut above the mine yard and will be reestablished on the cut slope. It will remain in service for access to the Standard Mine by its owners and employees. The Crested Butte bypass road will be paved and left intact after operations have ceased. AMAX will revegetate the cut and fill slopes but will not reclaim the road bed. Topsoil storage will be confined to an area located adjacent to the mine yard.

7.3.1.2 Keystone Mine Site

The Keystone Mine is a previously disturbed area consisting of stabilized tailing ponds, a mine adit, a mill site, the upper Mount Emmons roads, various access roads, and the heavy metals water treatment plant. The existing disturbances occupy a total of 53 ha (130 acres). Some of the upper Mount Emmons roads were constructed by AMAX above the Keystone Mine during exploration. Certain of these roads will not require reclamation since they will be lost as subsidence progresses. Portions of the roads are presently being reclaimed. Others will be reclaimed during operation or final reclamation phases of the Project, depending on whether they are needed for geologic or engineering observations. To avoid disturbing additional areas, portions of the Keystone Mine site may be used as a staging area for contractors during the development of the Mount Emmons Mine.

7.3.1.3 Ore Haulage Railway

Disturbances along the surface ore haulage railway will total 171 ha (423 acres) and will include the railroad, construction and maintenance access roads, four tunnel portals, one mine adit portal, and three contractors' yards. The actual width of disturbance associated with the railroad will vary greatly from place to place depending on the amount of cut and fill. The railroad construction and maintenance access roads will be surfaced with gravel and will be totally reclaimed after operations have ceased, as will the railroad bed itself. The relocated Kebler Pass Road and Carbon Creek Road will be graveled and left intact after operations have ceased. AMAX will revegetate the cut and fill slopes, but will not reclaim the road beds.

Of the five portals included along the surface ore haulage railway, the portal on the south side of Mount Axtell will have the largest associated disturbance. The bench at this location will include a contractor's yard and will be partly constructed of tunnel development rock. One of the portals at the Red Mountain tunnel will likewise have an associated contractors' yard, as will the north portal of the Mount Axtell tunnel, although both will be smaller than the yard at the south portal of the Mount Axtell tunnel. The two portals located on the north and south sides of Coal Creek, where the railroad daylights between Mount Emmons and Mount Axtell, will be connected by a fill. Development waste rock will be used to construct the fill. A culvert will be used to allow Coal Creek to pass under the fill.

7.3.1.4 Mill Site

Disturbances at the mill site will occupy a total of 123 ha (305 acres) and consist primarily of the mill yard, minor cut and fill slopes, the mill access road, and the topsoil stockpile. The mill access road will be paved and partially reclaimed following cessation of mining.

7.3.1.5 Tailing Deposition Site

The tailing deposition site and associated facilities will occupy a total of 501 ha (1,237 acres). The largest disturbance will result from dam construction and tailing deposition. Associated facilities will consist of the tailing interceptor conduit and service road, the tailing delivery line and service road, and the topsoil stockpile.

7.3.1.6 Reservoirs

Dams creating three reservoirs are currently planned to be constructed to supply Project water needs. The total disturbance resulting from creation of the reservoirs and associated access roads will be 65 ha (160 acres). The reservoirs and their graveled access roads will be permanent; thus, the only disturbances to be reclaimed will be the dam faces and associated construction disturbances.

7.3.1.7 Sand and Gravel Areas

Approximately 1.9 million cu m (2.5 million cu yd) of sand and gravel material will be required for construction and operation throughout the life of the Project. The specific sites for obtaining these materials have not yet been selected. The sites will be located as near as possible to the facilities requiring the largest quantities of sand and gravel (the mine, the railway, and the mill). The total disturbance due to sand and gravel mining (including roads, etc.) is estimated to be 81 ha (200 acres).

7.3.1.8 Subsidence

Subsidence will occur as a result of the mining of the Mount Emmons ore body. It is impossible to accurately predict the size of the actual subsidence or the zone of influence of the subsidence. The estimated actual subsidence may disturb 176 ha (434 acres) and the potential zone of influence may encompass 371 ha (917 acres). Since reclamation of subsidence is not practical and is not required by reclamation regulations, no reclamation is planned for the subsided area.

7.3.1.9 Buffer Zones

The proposed AMAX land exchange includes 405 ha (1,000 acres) of "buffer zone" areas to provide a buffer around and between areas of disturbance and eliminate the creation of "islands" within designated affected lands. Buffer zones may or may not actually be disturbed. AMAX's experience with other mining projects has demonstrated the difficulty in predicting all possible future facility requirements. Reclamation of such an area will be in accordance with the procedures designated for adjacent areas and adjusted to the specific setting.

7.3.2 RECLAMATION PLAN

The reclamation plan is organized into two parts. The first part, Reclamation Goals and Procedures (Section 7.3.2.1), outlines AMAX's reclamation goals and commitments and describes reclamation procedures to be implemented throughout the Project. The second part, Site Specific Reclamation (Section 7.3.2.2), describes reclamation procedures to be implemented at each specific disturbance site. This organization eliminates repetitious statements of procedural detail for each site.

7.3.2.1 Reclamation Goals and Procedures

7.3.2.1.1 Goals of Reclamation. Physical disturbance of land creates a situation which will further degrade for a period of time prior to reaching equilibrium and beginning to recover naturally. AMAX's reclamation goals are: (1) to reduce the interim period of continued degradation and (2) to initiate and accelerate the process of continuous natural ecological recovery. These goals are achieved by implementing the two major components of reclamation — stabilization and revegetation. The AMAX reclamation goals ensure that the reclamation performance standards of the Colorado Mined Land Reclamation Board (Rule 6) will be satisfied.

All areas for which reclamation is required and which are amenable to revegetation will be revegetated. Excessively steep cut slopes cannot be revegetated.

Existing vegetation throughout the Project area can be categorized as either forest or non-forest. Examples of non-forest vegetation types are Subalpine Meadow, Mountain Grassland, and Big Sagebrush Shrubland. Reclamation to "non-forest" is generally planned for these areas.

Reclamation to "open forest" is generally planned for most forest areas now vegetated by Spruce-Fir Forest, Lodgepole Pine Forest, or Aspen Woodland.

Reclamation to open forest or non-forest offers two distinct advantages: (1) the ecosystem will be returned to a structure similar to the existing structure, and (2) the reclaimed land will be amenable to a variety of beneficial uses by future generations.

7.3.2.1.2 Definition of Non-Forest and Open Forest Revegetation. Revegetation to non-forest will entail the establishment of grasses, shrubs, and forbs included in the seed mix presented in Section 7.3.2.1.8.

Revegetation to open forest will entail revegetation to non-forest plus the outplanting of tree seedlings at the rate of 741 stems/ha (300 stems/acre). The expected survival rate of tree seedlings is 60 to 80 percent. Maturation of approximately 371 stems/ha (150 stems/acre) will provide the desired open forest habitat.

Existing forest and non-forest vegetation canopy cover ranges from moderate to heavy (50 to 90 percent). Revegetation to open forest and non-forest by the methods described in this reclamation plan will produce a similar vegetation canopy cover.

Revegetation techniques, including seeding methods, seedbed preparation, seeding rates, and mulching are described in detail in subsequent sections.

7.3.2.1.3 Surrounding Land Uses. The present uses of land in the vicinity of the Mount Emmons Project include mining (hard rock and coal), commercial, residential, agricultural, educational, recreational, wildlife, and forestry. Uses of lands to be disturbed by the Mount Emmons Project are predominantly mining, range, and recreation. Reclamation to open forest and non-forest will lead to the development of a variety of ecological conditions capable of supporting any or all of these land uses.

7.3.2.1.4 Slopes and Grading. Finished cuts and fills will be graded to slopes appropriate to the soil type and terrain of the area consistent with construction economy and long term stability. Slopes will be designed to insure stability, prevent erosion and facilitate revegetation.

Cut and fill slopes will be permanently revegetated during the construction and operation phases and will have approximately 30 yr of growth by the time bench areas are revegetated during final reclamation. These highly stable slopes will not be redisturbed by regrading during final reclamation. Regrading during final reclamation will be limited to providing proper drainage and burying or covering unsalvageable materials when structures are dismantled. The final topography will be appropriate for the selected land uses.

7.3.2.1.5 Topsoil Stockpiling and Temporary Stabilization. Soil (both topsoil and subsoil) exists throughout the areas of disturbance in sufficient quantities to allow salvage and immediate use or stockpiling for future use. Soil will be salvaged from disturbed sites in quantities sufficient to allow spreading at the thicknesses indicated in the site specific reclamation descriptions. Respreading of soil is planned for areas which are conducive to revegetation and where the post-mining surface is expected to be composed of media unfavorable for rapid vegetation development. Such media include the mine site development rock, the railroad roadbed, and the waste rock cap of the tailing. Where practicable, soil will be respread on areas to be reclaimed immediately following removal to avoid stockpiling.

In some locations, the material at the surface following disturbance will be comprised of suitable topsoil, or subsoil, or both. Topsoil may or may not be salvaged at these locations; however, it will not be redistributed at such locations. Examples of these situations are roads in low slope with relatively shallow cuts and fills such as the mill access road.

Soil salvage will be concentrated in areas containing material with the best reclamation potential (material with moderate texture, good structure, dark color, and low salt hazard) as discussed in Sections 4.3.4, 5.3.3.3, 5.4.1.4.3, 5.4.2.4.3, 5.4.3.4.3 and 5.4.4.4.3, and within close proximity to the designated stockpile locations or areas of immediate use. Soil will be removed at most locations during construction. In the tailing area, soil removal will occur in stages, as dam construction progresses. Stockpiled soil will be stabilized until needed by means of stockpile design and a non-forest vegetation cover. When practical, stockpile slopes will average 3:1. Slopes longer than

23 m (75 ft) will have an intervening terrace for erosion control.

7.3.2.1.6 Topsoil Respreading and Seedbed Preparation. In general, sites with the least favorable growth media will be covered with topsoil prior to revegetation. The major type of unfavorable growth medium to be encountered during the Mount Emmons Project reclamation effort is waste rock. However, the only detrimental characteristic of waste rock is its sterility. Research conducted on Mount Emmons waste rock and ore samples indicates that the potential for development of acid conditions in these materials will not be a problem. Samples of waste rock produced during exploration at the Mount Emmons Project were analyzed by Rinehart Laboratories Inc. (1979a and 1980a,b) for potential H_2SO_4 production and potential H_2SO_4 uptake using the proposed EPA extraction procedure. Results of these analyses showed potential H_2SO_4 production of 10.5 kg/m ton (21 lb/ton) and potential H_2SO_4 uptake of 50.5 kg/m ton (101 lb/ton). Thus, no serious acid problems are likely to result from the weathering of waste rock. Also analyzed were samples of tailing material which showed a potential H_2SO_4 production of 20 kg/m ton (40 lb/ton) and a potential acid uptake of 21 kg/m ton (42 lb/ton), indicating that no serious acid production problem is likely to develop in the tailing material either.

Excessively compacted surfaces will be ripped with dozers or graders to improve permeability. In areas where resoiling is scheduled, the reserved soil will be placed at the depths indicated for each area in the site specific reclamation descriptions. No attempt will be made to replace topsoil on cut slopes too steep to hold the soil.

In areas to be broadcast seeded, the surface will be scarified to prepare the seedbed properly. The rough conditions immediately following construction of cuts and fills or ripping of platform areas are optimum for broadcast seeding. In areas to be drill seeded, the seedbed surface will be relatively smooth and firm. Operations such as discing and cultipacking will be used as necessary.

At the time of seeding, 20-20-10 fertilizer will be applied at the rate of 112 kg/ha (100 lb/acre), or as determined by laboratory analysis.

7.3.2.1.7 Seeding Methods and Rates. Because of the rough and steep conditions normally encountered in the mountains, it is anticipated that most areas will be broadcast seeded. Some large flat (or near flat) areas such as the tailing pond may be drill seeded.

The seeding rate for broadcast seeding will be approximately 50 kg pure live seed (PLS)/ha (45 PLS lb/acre), and for drill seeding will be approximately 25 kg PLS/ha (22 PLS lb/acre).

7.3.2.1.8 Seed Mixture. The seed mix described below will be used in all areas to be revegetated. Of the species now commercially available, those listed in Table 7.3-2 are the most desirable for stabilizing the sites and initiating the process of ecological recovery. Many of the species are domestic forage species which have proven their adaptation to rapid establishment at high altitude. Additional desirable native species listed in a footnote on Table 7.3-2 may be substituted into the mix as they become available. The seed mix and revegetation methods will provide a diverse, effective, and long-lasting vegetative cover.

Table 7.3-2 SEED MIX FOR MOUNT EMMONS REVEGETATION[a]

Scientific Name	Common Name - Variety	% by Weight in Mixture
Agrostis alba	Redtop	3
Alopecurus arundinaceus	Creeping Foxtail	10
Bromopsis inermis	Smooth Brome - Manchar	15
Dactylis glomerata	Orchard Grass	5
Deschampsia caespitosa[b]	Tufted Hairgrass	2
Festuca arizonica	Arizona Fescue	4
Festuca ovina	Hard Fescue - Durar	8
Festuca rubra	Red Fescue - Pennlawn	8
Phleum pratense	Timothy - Climax	5
Poa ampla	Big Bluegrass - Sherman	3
Poa pratense	Kentucky Bluegrass - Newport	3
Secale cereale	Rye - Balboa	20
Trifolium repens	White Dutch Clover	10
Trisetum spicatum[b]	Spike Trisetum	2
Native Shrubs	See Section 7.3.2.1.8	1
Native Forbs	See Section 7.3.2.1.8	1
	TOTAL	100

[a] The following species are not presently commercially available. They are very desirable, however, and may be added as they become available: *Agropyron latiglume* (subalpine wheatgrass), *Bromopsis ciliatus* (fringed brome), *Bromopsis inermis* ssp. *pumpellianus* (pumpelly brome), *Bromopsis lanatipes* (wooly nodding brome), *Bromopsis porteri* (nodding brome), *Elymus glaucus* (blue wildrye), *Festuca thurberi* (Thurber fescue), *Phleum commutatum* (alpine timothy), *Poa alpina* (alpine bluegrass), *Poa epilis* (skyline bluegrass), *Poa fendleriana* (mutton bluegrass), and *Poa glauca* (Greenland bluegrass).

[b] *Deschampsia caespitosa* and *Trisetum spicatum* are native species which appear likely to be available by the time revegetation begins. If not available, they will be deleted from the mix until such time as they are available.

The shrub component of the seed mix (Table 7.3-2) will include at least four of the following native species:

Acer glabrum	Mountain maple
Amelanchier spp.	Serviceberry
Artemisia tridentata spp. *vaseyana*	Vasey big sagebrush

Krascheninnikovia lanata	Winterfat
Mahonia repens	Oregon grape
Prunus virginiana var. *melanocarpa*	Chokecherry
Ribes aureum	Golden currant
Rosa woodsii	Woods rose
Sambucus racemosa spp. *pubens*	Red-berried elder
Symphoricarpos oreophilus	Mountain snowberry

These shrub species are commercially available on an intermittent basis. The inclusion of a minimum of four species allows for the possibility of unavailability of some species during any given year.

The following shrub species are desirable but not commercially available at present. Should they become available, some may be included in the seed mix.

Juniperus communis	Common juniper
Lonicera involucrata	Twinberry
Ribes cereum	Wax currant
Ribes lacustre	Prickly currant
Ribes montigenum	Subalpine prickly currant
Rubus parviflorus	Thimbleberry
Rubus idaeus spp. *sachalinensis*	Red raspberry
Salix scouleriana	Scouler willow
Shepherdia canadensis	Buffaloberry

Shrub establishment may be enhanced by the outplanting of seedlings or cuttings.

The forb component of the seed mix (Table 7.3-2) will include at least four of the following native species:

Achillea lanulosa	Common yarrow
Aster chilensis spp. *adscendens*	Pacific aster
Aster glaucoides	Glaucous (smooth) aster
Erigeron speciosus var. *macranthus*	Showy daisy
Eriogonum umbellatum	Sulfur-flower
Heliomeris multiflora	Showy goldeneye
Osmorhiza occidentalis	Sweetanise
Penstemon strictus - *named variety Bandera*	Rocky Mountain penstemon
Thermopsis montana	Golden banner

These species are also commercially available on an intermittent basis.

7.3.2.1.9 Trees. The tree species to be outplanted for revegetation to open forest are:

Picea engelmannii	Engelmann spruce
Abies lasiocarpa	Subalpine fir
Pinus contorta var. *latifolia*	Lodgepole pine
Pseudotsuga menziesii	Douglas-fir
Populus tremuloides	Quaking aspen

Planted stock will be protected by shingles or similar material during the establishment period. These woody plants may be acquired variously from commercial sources, the Colorado State Forest Service, or grown at the Mount Emmons Project underground greenhouse.

7.3.2.1.10 Planting Times. Where possible, seeding will take place immediately following construction. If immediate seeding is not practical, disturbed areas will be revegetated during the growing season following completion of the disturbance.

Because the seed mixture is composed primarily of cool season species and the wettest season is winter, the preferred time of seeding will be the fall, after September. Seeds planted at this time enjoy the benefits of winter moisture, and for species with a dormancy factor, the cool, wet conditions under the snowpack can break dormancy in many species. Efforts will be made to accomplish most seeding during the spring or fall. However, because of the extremely short field season, logistics will require planting during the summer as well.

Even though hardened or dormant at the time of planting, woody plant stock will not be planted prior to late June because of the possibility of hard frost before that time.

7.3.2.1.11 Mulching. Mulch may be used in any of a number of different revegetation or erosion control situations, irrespective of slope or aspect. The type of mulch selected for use will be appropriate to fulfill the specific needs of each situation. It is expected that excelsior mat will be utilized on the most difficult erosion and revegetation areas, and hydromulch will be used on moderately difficult revegetation areas. Jute netting, straw and net, or other similar materials may also be used as deemed appropriate. Mulch will not be used unless necessary.

It is anticipated that very little mulching will be necessary on gentle north- or east-facing slopes. Steeper slopes will require more mulching, and steep south- or west-facing slopes may receive a solid covering of mulch. Mulch may also be used to aid revegetation when reseeding areas which initially failed to develop a satisfactory cover.

7.3.2.1.12 Maintenance Fertilization. The high quality growth media encountered throughout the Project area and the use of topsoil on particularly difficult areas will minimize the quantity and frequency of fertilization required to achieve self-sustaining vegetation. AMAX's high altitude reclamation experience indicates that two or three applications of nitrogen fertilizer spaced throughout a 5 yr period are sufficient to achieve the desired goal. Ammonium nitrate will be applied at a rate of

112 kg/ha (100 lb/acre), or as determined by soils tests, late in the first growing season and during the third and perhaps fifth growing seasons. It is expected that within 5-yr after planting, the natural nitrogen cycle will be reestablished in the soils, and no further nitrogen fertilization will be necessary or desirable.

Excessive nitrogen fertilization can result in development of an oversized biomass with a "golf course" appearance, or can lead to the dominance of less desirable species. However, if nitrogen deficient problem areas develop, additional fertilizer will be applied.

7.3.2.1.13 Structure Dismantling. It is impossible to predict whether or not it might be beneficial to leave any of the structures associated with the Project in place after mining has ceased. No structure would be left unless it provided a beneficial use. With the exception of certain flood control and water management facilities the present plan is to remove all surface facilities and structures during final reclamation. Materials of no salvage value such as concrete and asphalt will be buried, covered at the site, or disposed of at an approved disposal site.

Powerlines belonging to the Gunnison County Electric Association will remain their responsibility. As with structures, in-house powerlines will be removed and salvaged unless they provide a post-mining beneficial use.

7.3.2.1.14 Post-Mining Water Treatment. Following the closure of the Mount Emmons and Keystone mines, no water treatment problems are anticipated. Likewise, the earthen dam retaining the deposited tailing at Alkali Basin will not allow seepage from the tailing. Continual water treatment facilities will probably be unnecessary for any of the Mount Emmons Project facilities; however, if treatment is necessary, AMAX will do whatever is required by the applicable laws at the time. All facilities have been designed to minimize disturbance to the hydrologic balance.

7.3.2.1.15 Post-Mining Flood Control. Flood control has been integrated into the overall design of the Mount Emmons Project facilities. At the termination of operations, the permanent flood protection facilities will be adequate and will require a minimum of maintenance to remain functional.

Two separate flood types were considered in the design of all facilities — floods due to snowmelt and floods due to rainfall (Table 7.3-3). The design of each structure was based on the most critical type of flood which could affect that structure. Depending on the hazard potential or risk of failure of a structure, either the Probable Maximum Flood (PMF) or the 100-yr flood was used for design purposes.

Coal Creek. Flood protection will not be a major concern for the mine site since there will be no major impoundments or obstructions, and the mine plant facilities will be located above the 100-yr floodplain.

Table 7.3-3 MOUNT EMMONS PROJECT FLOOD HYDROLOGY

		Probable Maximum Runoff			
		Snowmelt		Rainflood	
Drainage Basin	Drainage Area (sq. mi.)	Peak (cfs)	Volume (ac-ft)	Peak (cfs)	Volume (ac-ft)
North Interceptor	5.03	131[a]	N/A[b]	-	-
South Interceptor	2.47	56[a]	N/A	-	-
Tailing Pond (Below Interceptors)	1.48	N/A	2,660	N/A	590
Total Above Tailing Pond	6.40	143	9,770	10,500	2,430[c]
Incremental Basin Between Tailing Pond and Mill Makeup Water Reservoir	1.55	N/A	N/A	3,170	620
Carbon Creek Reservoir	6.40	N/A	N/A	10,030	2,515
Coal Creek at Mount Axtell Tunnel Portal	13.10	100 year flood flow = 3,220 cfs			

[a] Aggregate total of 16 individual subbasins.
[b] N/A = not applicable.
[c] Does not include portion of rainfall flood diverted by interceptors.

Carbon Creek. All Carbon Creek facilities will be located outside of the floodplain except for the Carbon Creek dam and reservoir and railroad. The dam and spillway are designed to route and pass the PMF safely with the reservoir full to the spillway elevation at the beginning of the flood. No change will be made on this structure after the cessation of mining; therefore, it will continue to be safe for future floods. A section of the railroad fill will be removed during final reclamation to allow uninhibited passage of a PMF.

North and South Interceptors. The north and south interceptors will divert flood flows around the tailing pond and the mill make-up water reservoir. The diverted water will be returned to Alkali Creek at a point downstream from the make-up water reservoir. These systems will be winterized and designed to carry all normal runoff, including the probable maximum snowmelt flood. A portion of the rainfall flood will also be diverted or stored and released into the interceptor at a controlled rate. These facilities will remain fully operational after mining ceases.

Tailing Pond. The tailing pond has been designed to contain the PMF runoff at any time during its operating life. After tailing deposition ceases, the normal inflow from the area which lies below the interceptors will be diverted from the surface of the tailing pond by means of a spillway. This will result in a 1480 ha (12,000 acre ft) flood surcharge storage capability below the crest of the earthfill dam. An emergency spillway will be constructed during the final stage of the tailing pond development and will be retained after operations cease. With the combination of 1480 ha (12,000 acre ft) of surcharge and a permanent spillway, the PMF will be controlled.

Mill Make-up Water Reservoir. The mill make-up water dam and reservoir were designed to route and pass the PMF safely. The facility will be left intact after operations cease.

7.3.2.1.16 Plot Studies. Revegetation test plots were first established at the Climax Mine in 1964. Revegetation test plots were initiated at the Keystone Mine site soon after acquisition of the property and will be continued there and at other AMAX facilities.

7.3.2.2 Site-Specific Reclamation

Reclamation plans for each specific site listed in Table 7.3-1 are presented in the following paragraphs.

7.3.2.2.1 Mine Site. The mine site area covers a total of 93 ha (229 acres). Of this, the cut and fill slopes occupy 21 ha (53 acres), the mine yard occupies 30 ha (75 acres), the mine access road covers 30 ha (75 acres), the mine topsoil stockpile occupies 5 ha (11 acres), and the Crested Butte bypass road occupies 6 ha (16 acres).

Presently, the area which will be the mine site is a patchwork of about 75 percent forest and 25 percent non-forest. The mine site will be reclaimed to open forest and non-forest in a patchwork of similar proportions. Figure 7.3-1 depicts the conceptual mine site reclamation sequence, while Figure 9.2-5 shows an artist's rendition of the mine site following reclamation.

Mine Yard Slopes. It is estimated that 30 percent of the cut slopes (15 percent of the total slopes) will be at or near vertical and therefore unrevegetatable. This leaves 18 ha (45 acres) of slopes which will be revegetated with the aid of soil redistributed to an average depth of 15 cm (6 in); 36,300 bcy (bank cubic yards) of soil will be salvaged for this purpose. The cuts and fills will be revegetated during the late construction and early operation phases.

Mine Yard. After operations cease, structures will be dismantled, and the 30 ha (74 acres) of mine bench will be ripped and revegetated with the aid of 30 cm (12 in) of top soil; 119,400 bcy of soil will be stockpiled for this purpose.

Mine Topsoil Stockpile. In addition to the 155,700 bcy of topsoil to be salvaged during construction of the mine site for use in revegetating the mine site disturbances, 32,300 bcy of soil will be salvaged for use in revegetating certain portions of the Keystone Mine site disturbance (Section 7.3.2.2.2). The 5 ha (11 acres) topsoil stockpile area will be reclaimed after the soil is redistributed by simply scarifying and planting.

Mine Access Road. The 30 ha (75 acres) of disturbance created by the mine access road is comprised of 9 ha (22 acres) of roadbed and 21 ha (53 acres) of slopes. It is estimated that good quality soil will be in place on 25 percent of the slopes and that 50 percent of the cut slopes (25 percent of the total slopes) will be at or near vertical and therefore unrevegetatable. This leaves 11 ha (27 acres) of slopes to be revegetated following construction with the aid of soil redistributed to an average depth of 15 cm (6 in); 21,800 bcy of soil will be salvaged for this purpose. The roadbed will be left as a permanent road after the mine closes to allow inspection.

Crested Butte Bypass Road. The 4 ha (9 acres) of cut and fill slopes along the Crested Butte bypass road will be revegetated using 15 cm (6 in) of topsoil during construction; 7,300 bcy of topsoil will be salvaged for this purpose. The roadbed will not be reclaimed because it will be a permanent public road.

7.3.2.2.2 Keystone Mine Site. The old Keystone Mine site covers a total of 53 ha (130 acres). Of this, the four old tailing ponds occupy 22 ha (54 acres), the old mill site and heavy metals water treatment plant occupy 16 ha (40 acres), and the upper Mount Emmons roads occupy 15 ha (36 acres). Although the existing disturbances at the Keystone Mine site are unrelated to the proposed Mount Emmons Project, certain portions of the previously disturbed area may be used as a staging area for contractors during the development of the Mount Emmons Mine.

As with the Mount Emmons Mine site, a forest/non-forest patchwork probably existed at the Keystone Mine site prior to the initial disturbance of the area in the early 1900's. The site will be reclaimed to about 75 percent forest and 25 percent non-forest, approximating the assumed pre-disturbance conditions.

Keystone Tailing Ponds. After acquisition of the Keystone property in 1977, AMAX stabilized the four old tailing ponds and began reclaiming them in stages using manure, sawdust, and lime amendments. Reclamation of the tailing ponds is anticipated to be completed in 1981.

Old Mill Site and Heavy Metals Water Treatment Plant. Areas at the Keystone Mine site used for staging during construction will be reclaimed when the space is no longer needed. The heavy metals water treatment plant and associated facilities will be salvaged and the area reclaimed when it is no longer needed. The 16 ha (40 acres) of disturbed area will be ripped and revegetated using 15 cm (6 in) of topsoil. As discussed in Section 7.3.2.2.1, 32,300 bcy of topsoil will be salvaged from the Mount Emmons Mine site during construction and stored in the mine site topsoil stockpile for later use at the Keystone Mine site.

Upper Mount Emmons Roads. Roads constructed by AMAX above the Keystone Mine on Mount Emmons during exploration cover approximately 15 ha (36 acres). Some of these roads will be reclaimed during the construction phase by regrading, ripping, and broadcast seeding. Some roads must remain during operations for geologic/engineering observations, and AMAX may be requested to leave other roads. Still others will not require reclamation since they will be lost as subsidence progresses. The remaining roads for which AMAX is responsible will be regraded for drainage, ripped, and reclaimed during the final reclamation phase.

7.3.2.2.3 Ore Haulage Railway. The ore haulage railway occupies a total of 171 ha (423 acres). Of this, the railroad bed occupies 11 ha (26 acres), the cut and fill slopes along the railroad occupy 31 ha (77 acres), the construction and maintenance access roads occupy 47 ha (117 acres), the portal areas and associated contractors' yards occupy 24 ha (60 acres), the cut and fill slopes at the portal areas occupy 6 ha (14 acres), the Coal Creek fill occupies 16 ha (39 acres), the railway topsoil stockpiles occupy 1.6 ha (4 acres), the relocated Kebler Pass Road occupies 10 ha (25 acres), and the Carbon Creek Road improvement occupies 25 ha (61 acres).

Presently, the area along the railway surface is about 60 percent forest and 40 percent non-forest. The ore haulage railway and associated disturbances will be reclaimed to open forest and non-forest as appropriate throughout to complement existing conditions.

Railroad Bed. After production has ceased, all structures will be dismantled. The 11 ha (26 acres) of the railroad bed will be ripped and revegetated using 30 cm (12 in) of topsoil; 41,900 bcy of soil will be stockpiled for this purpose.

Railroad Cut and Fill Slopes. It is estimated that good quality soil will be in place on approximately 25 percent of the cut and fill slopes (8 ha or 19 acres) and that an additional 5 percent of the slopes (10 percent of the cut slopes) will be at or near vertical and therefore unrevegetatable. This leaves 22 ha (54 acres) of slopes which will be covered with 15 cm (6 in) of topsoil and revegetated following construction; 43,600 bcy of soil will be salvaged for this purpose.

Railroad Construction and Maintenance Access Roads. The 47 ha (117 acres) of disturbance created by the roads is comprised of 38 ha (94 acres) of slopes and 9 ha (23 acres) of roadbed. It is estimated that good quality soil will be in place on approximately 50 percent of the cut and fill slopes (19 ha or 47 acres) and that an additional 5 percent of the slopes (10 percent of the cut slopes) will be at or near vertical and therefore unrevegetatable. This leaves approximately 17 ha (42 acres) of slopes which will be revegetated using approximately 15 cm (6 in) of topsoil; 33,900 bcy of topsoil will be salvaged for this purpose.

After operations cease, the 9 ha (23 acres) of roadbed will be reclaimed in sections, in coordination with reclamation of the railway. Pipelines buried adjacent to the railway will remain permanently. The roads will be ripped, covered with 15 cm (6 in) of topsoil, and revegetated; 18,600 bcy of soil will be salvaged for this purpose and stored in an appropriate location.

Portal Areas and Associated Contractors' Yards. Following completion of tunnel construction, the contractors' yards at both ends of the Mount Axtell tunnel and the north end of the Red Mountain tunnel, which occupy 20 ha (50 acres), will be ripped and revegetated using 30 cm (12 in) of topsoil. After operations cease, the portals will be sealed and structures will be dismantled. Portal maintenance areas (4 ha or 10 acres) required through the life of the mine will be reclaimed during final reclamation along with the railroad bed. Approximately 96,800 bcy of soil will be stockpiled for reclamation of the portal areas and associated contractors' yards.

Portal Area Slopes. The cut and fill slopes at the portal areas (including those associated with the contractors' yards) occupy 5.7 ha (14 acres). Following construction, they will be revegetated using 15 cm (6 in) of topsoil; 11,300 bcy of soil will be salvaged for this purpose.

Coal Creek Fill. The Coal Creek fill will be made up of waste rock from the development of the Mount Emmons ore haulage adit. After operations cease, the culvert will be removed and the stream channel will be returned to its original length and grade. The stream banks will be returned to a grade of 3 (horizontal): 1 (vertical) or the grade of the existing slope, whichever is steeper. The 16 ha (39 acres) of slopes on both sides of Coal Creek will be revegetated using 15 cm (6 in) of topsoil; 31,500 bcy of topsoil will be salvaged for use on the cut and fill slopes and the Coal Creek fill.

Railway Topsoil Stockpiles. Several topsoil stockpiles occupying a total of 1.6 ha (4 acres) will be located along the length of the railway at appropriate intervals. Actual stockpile locations will be selected during final design and construction. The stockpile areas will be reclaimed by scarifying and planting after the topsoil has been redistributed.

Relocated Kebler Pass Road. The slopes along the relocated Kebler Pass Road (8 ha or 20 acres) will be revegetated using 15 cm (6 in) of topsoil; 16,100 bcy of soil will be salvaged for this purpose. The roadbed will not be reclaimed because it will be a permanent public road.

Carbon Creek Road Improvement. Cuts and fills along the improved Carbon Creek Road include approximately 16 ha (39 acres) and will be revegetated following construction. It is anticipated that the cuts and fills will be shallow and that the in-place soil will be suitable for revegetation.

7.3.2.2.4 Mill Site. The mill site covers a total of 123 ha (305 acres). Of this, the cut and fill slopes occupy 5 ha (12 acres), the mill yard occupies 27 ha (67 acres), the mill access road from the East River occupies 88 ha (219 acres), and the mill topsoil stockpile occupies 3 ha (7 acres).

Vegetation at the proposed mill site area is presently non-forest and the area will be reclaimed to non-forest. Figure 7.3-2 depicts the conceptual reclamation sequence for the mill site, while Figure 9.4-7 is an artist's rendition of the area following reclamation.

Mill Yard Slopes. It is expected that good quality soil will be in place on the slopes following construction. The 5 ha (12 acres) of slopes will be revegetated without the aid of topsoil.

Mill Yard. After operations cease and all structures are dismantled, the 27 ha (67 acres) of mill yard will be ripped and revegetated using an average of 30 cm (12 in) of soil; 108,100 bcy of soil will be stockpiled for this purpose.

Mill Access Road. The 87 ha (219 acres) of disturbance created by the mill access road is comprised of 27 ha (66 acres) of roadbed and 62 ha (153 acres) of slopes. It is estimated that good quality soil will be in place on 50 percent of the cut and fill slopes (31 ha or 76 acres); 61,300 bcy of soil will be salvaged and respread following construction to a depth of 15 cm (6 in) on those slopes requiring soil, and the entire 62 ha (153 acres) will be revegetated.

The roadbed from the East River to the tailing dam (14 ha or 35 acres) will be left as a permanent road for access to the tailing dam. After reclamation of the mill yard is complete, the remaining 13 ha (32 acres) of roadbed from the tailing dam to the mill site will be ripped and revegetated using 15 cm (6 in) of topsoil; 25,800 bcy of soil will be salvaged for this purpose and stored in the mill topsoil stockpile.

Mill Topsoil Stockpile. The 3 ha (7 acres) topsoil stockpile area will be reclaimed after the soil is redistributed by scarifying and planting.

7.3.2.2.5 Tailing Deposition Site. The tailing deposition site and associated facilities occupy a total of 501 ha (1,237 acres). Of this, the tailing pond surface occupies 399 ha (985 acres), the tailing dam face occupies 22 ha (55 acres), the tailing interceptor conduit and service road occupy 34 ha (84 acres), the tailing delivery line occupies 13 ha (32 acres), and the topsoil stockpile occupies 33 ha (81 acres).

Presently the vegetation in the tailing deposition site area is non-forest. As such, the area will be reclaimed to non-forest. Figure 7.3-3 shows the tailing area conceptual reclamation sequence; Figure 9.4-9 is an artist's rendition of the tailing area following reclamation.

Tailing Pond Surface. The tailing surface will ultimately be reclaimed by capping the pond with waste rock and topsoil. Because of continued tailing deposition, the tailing pond surface cannot be reclaimed until after operations cease. Prior to the cessation of operations, tailing will be deposited around the west and south edges of the pond to establish a minimum grade drainage toward the northeast corner adjacent to the dam. Flood protection and provision for drainage are discussed in Section 7.3.2.1.15.

Some waste rock might be stockpiled for reclamation purposes at the mill throughout the life of the mine. Mining will cease when it is no longer economic to mill the ore; however, the mine and haulage system will be kept operational as long as necessary to supply waste rock to the tailing area for covering and stabilizing the surface. Approximately 1.8 million cu m (2.4 million cu yd) of waste rock will be hauled to and spread over the 399 ha (985 acre) surface to a depth of 61 cm (24 in). It is expected that most of the spreading will have to be accomplished in the winter, when the tailing is frozen and capable of supporting equipment.

Following emplacement of the waste rock cap, 490,000 bcy of topsoil stockpiled during construction of the tailing dam and the mill make-up water dam will be distributed evenly on the rock to an average depth of 9 cm (3.5 in) and revegetated. The stability provided by the rock will allow the topsoil to be spread during the summer months. The rock provides an excellent capillary and oxygen barrier and is, with the soil amendment, a relatively good growth medium. And, as indicated in Section 7.3.2.1.6, the net acid-producing potential of both the rock and the tailing is negative. The entire capping process may require two or three years. However, revegetation of the capped tailing will proceed concurrently with the capping process.

Tailing Dam Face. The tailing dam faces resulting from the interim stages of dam construction will be temporarily revegetated. The final dam face (22 ha or 55 acres) will be ripped and revegetated after the final tailing dam is completed. Topsoil is not expected to be necessary. The soils information (Sections 4.3.4 and 5.2.4.1.3) indicates that the material borrowed from within the tailing basin for dam construction will probably be good quality soil. If, for some reason, the material comprising the final dam face is not a good quality soil, the dam face will be topsoiled to a depth of 15 cm (6 in).

Tailing Interceptor Conduit and Service Road. The tailing interceptor conduit, which occupies 34 ha (84 acres), will control runoff onto the tailing disposal area. It will be revegetated and left in place following reclamation for flood control. Access along the interceptor must also be maintained. Therefore, everything except a small track will be revegetated to assure erosion control. It is expected that good quality soil will be in place throughout the length of the interceptor.

Tailing Delivery Line and Service Road. After operations cease, the tailing line will be dismantled. The 13 ha (32 acres) of service road and tailing line will then be ripped and revegetated using an average of 15 cm (6 in) of topsoil; 25,800 bcy of soil will be salvaged for this purpose.

Tailing Topsoil Stockpile. The 33 ha (81 acres) topsoil stockpile will be reclaimed by scarifying and seeding after the soil is redistributed.

7.3.2.2.6 Reservoirs. The three reservoirs occupy a total of 65 ha (160 acres). Of this, the water surfaces at the Carbon Creek, mill make-up water, and Elk Creek reservoirs occupy 5, 20 and 9 ha (13, 50, and 23 acres), respectively, while the dam faces of each occupy 4, 6, and 8 ha (11, 14, and 20 acres), respectively. The reservoirs and associated access roads will be permanent. Thus, reclamation is planned for the faces of the dams, the cut and fill slopes of the roads, and the construction disturbance around the dams.

Vegetation in the area to be occupied by the mill make-up water reservoir is presently non-forest, while the vegetation in the areas to be occupied by the Carbon Creek reservoir and the Elk Creek reservoir is forest. The dam faces will be reclaimed accordingly. Figure 7.3-4 depicts the reclamation sequence for the Carbon Creek reservoir area, while Figure 7.3-3 shows the mill make-up water reservoir reclamation sequence. Figure 9.3-2 is an artist's depiction of the Carbon Creek reservoir area following reclamation.

Reservoir Dam Faces. At the end of construction, the 18 ha (45 acres) of dam faces at all three reservoirs will be ripped and revegetated. As with the tailing dam face, the material borrowed from within the reservoir basins for dam construction is expected to be good quality soil; thus, no topsoiling will be required. If any of the dam faces do not have good quality soil, they will be topsoiled to a depth of 15 cm (6 in).

Reservoir and Pumphouse Access Roads. Following construction, 7.3 ha (18 acres) of slopes along the reservoir and pumphouse access roads will be revegetated. It is estimated that good quality soil will be in place on 50 percent of the slopes, leaving 3.7 ha (9 acres) to be topsoiled to a depth of 15 cm (6 in); 7,300 bcy of soil will be salvaged for reclamation of the slopes. Reservoir pipelines buried adjacent to the reservoir access roads will remain permanently, as will the roadbeds themselves.

7.3.2.2.7 Sand and Gravel Areas. Sites for obtaining sand and gravel for use throughout the life of the Project have yet to be selected. An estimated 81 ha (200 acres) may be required for this aspect of the Project.

The sites will be reclaimed to open forest or non-forest as appropriate with the setting. All topsoil will be salvaged from the areas prior to sand and gravel mining and will be used in reclaiming the sites. Any lakes formed in mining and left as part of the reclamation of a site will be irregular in shape with shore slopes no greater than 3 (horizontal): 1 (vertical).

REFERENCES
(Section 7.0)

Briscoe, Maphis, Murray, Lamont, Inc. (BMML). 1980. Social and economic studies, EIS workbook. Boulder, Colo.: BMML, prepared for Gunnison County.

Rinehart Laboratories Inc. 1979a. Mount Emmons Project studies, three rock samples (waste rock). Arvada, Colo.: Rinehart Laboratories; prepared for AMAX.

__________ 1979b. Metals laboratory Mount Emmons Project EP study. Arvada, Colo.: Rinehart Laboratories; prepared for AMAX.

__________ 1980a. Mount Emmons Project leaching studies. Arvada, Colo.; Rinehart Laboratories; prepared for AMAX.

__________ 1980b. Solid waste-EPA extraction, sludge and wasterock. Arvada, Colo.; Rinehart Laboratories; prepared for AMAX.

Snow, D.T. 1980. Mount Emmons ground water hydrology. Prepared for AMAX.

Appendix B. Mitigation Measures

APPENDIX B: MITIGATION MEASURES

PAGE REFERENCE

Vegetation 302
Wildlife 305
Aquatic Ecology. 309
Energy 310
Water. 310
Air Quality. 312
Noise. 314
Cultural Resource. 315
Visual Resource. 316
Outdoor Recreation 317
Wildland Fire. 318
Transportation 318
Socioeconomic. 319
Geological Hazards 322
Soils. 323
Land Use 324
Avalanche Hazard 325
Other. 325

This Appendix contains reasonable mitigation measures that apply to Alternatives 3-7. These mitigation measures have been consolidated from the following sources; Forest Service, BMML (1981 a-d) and AMAX (1981a). The mitigation measures that the Forest Service may require to mitigate impacts that occur on NFS lands are identified by an asterisk (*) and are assumed to be in place for the impact analyses described in Chapter 4. It must be clearly understood that NEPA does not require mitigation measures be implemented by the proponent or anyone else. Likewise, it must be understood that the task of the Forest Service required by NEPA is to disclose impacts and consequences of the proposed action and alternatives to that action. In doing so, the following must be recognized:

(1) Any mitigation required by the Forest Service will relate only to impacts on NFS lands and must be based on legal authorities of the Forest Service.

(2) The disclosure of impacts and the discussion of mitigation methods is for the purpose of providing those agencies of Government (Federal, State, and local) with decision authority regarding the Project, information they may use in approving or denying within their authority. Such information is also provided so that the proponent and the public at large is aware of at least part of the information being used by the various agencies in making their decisions.

(3) When determining what mitigation measures will be required on NFS lands, Forest Service officials must consider: authorities under existing law, regulation, and policy; economic feasibility; land management objectives; and the impacts and consequences disclosed in the EIS. Forest Service required mitigation must be in accord with the Forest Service authorities which apply to the activity under consideration. The Record of Decision will identify, by inclusion or specific reference, the mitigation measures and necessary monitoring programs. The required Forest Service mitigation measures will become terms and conditions of any permit or authorization.

(4) Forest Service officials will sit at the negotiating table, if requested, to assist other levels of government, as well as the propo

nent, in interpreting the EIS information and to provide technical assistance relative to the Forest Service area of professional expertise. The role of the Forest Service should not be considered as "mitigation facilitator."

Table B-1 VEGETATION MITIGATION MEASURES

Impact	Mitigation
Disturbed and tailing areas in need of reclamation.	AMAX has prepared a detailed reclamation plan which is included in Appendix A for Alternative 2. These plans are too detailed to require one for each alternative but it is assumed that similar principles would be applied to develop a reclamation plan for the selected Alternative.
Keystone Iron Bog - potential drying of springs	Monitor spring flows and water quality. (*) Create hydrostatic head within faults by pumping water from the old Keystone Mine or the Mount Emmons mine into the faults which feed springs to maintain present water quantity and quality. (*) Conduct transplant viability study to determine whether seeding or transplanting sundews into bogs of similar characteristics is viable.(*)
Vegetation destruction and alteration	Minimize disturbance areas through design and on-the-ground control. (*) Roads will not be built solely for surveying purposes. (*) Revegetate disturbances as quickly as practical with the vegetation types disturbed. (*) Use natural vegetation forms in construction. (*) Cut and clear using natural vegetation "lines" and clear only for direct needs of construction. (*) Vegetation will not be removed until a final location has been established. Oak brush may be cleared earlier if necessary. (*) Minimize disturbance in sensitive alpine-subalpine habitats. (*)

Table B-1 (continued)

Impact	Mitigation
Vegetation destruction and alteration (continued)	Restrict rights-of-way clearing for powerlines that actually needed for electrical clearance. Topping will be used where applicable. (*) Trees less than 16 feet in height will not be removed from powerline rights-of-way. Where possible, trees taller than 16 feet will be left at major road crossings. (*) Utilize high conductor clearances in forested areas to allow the retention of all but the tallest trees in rights-of-way near roads and highways. (*) Monitor molybdenum levels in plant tissues and soils near the mine, mill, and ore haulage corridor. (*)
Loss or disturbance of riparian or wetland vegetation and farmland	Purchase existing wetlands of similar or better quality for management as wetlands by state or federal agencies or such organizations as the Nature Conservancy. Land that has been purchased for exchange with the U.S. Forest Service contains at least 331 acres of wetlands. Leave freshwater reservoirs for public use following project closure. (*) Place powerline towers and use long spans to avoid impacts on riparian vegetation and farmlands where possible. (*)
Decreased productivity due to dust	Use dust controls (water, petrocohesives) on exposed gravel roads, tailing beach areas, etc. (*) Pave major access roads, in-plant roads, and parking lots. (*) Maintain water pool on tailing pond. (*)
Increased human disturbance and housing development in cottonwood bottom that is used as an eagle roost areas	Implement employee awareness programs. Protect the area from unnecessary intrusion.
Accumulation of cleared materials	Dispose of cleared materials burning, burial, stockpiling for later reclamation, or distribution as firewood as approved at site specific locations by the landowner or responsible official. (*)
Removal of commercial timber	Removal of commercial timber on National Forest System lands will be subject to standard R-2 timber sale clauses and stipulations for timber settlement procedures. Timber to be cut shall be so designated by the Forest Service.(*)

Table B-1 (continued)

Impact	Mitigation
Increased human populations may increase pressure on remote areas and sensitive areas such as alpine systems, research sites, etc. Activities such as bird-watching and wildlife photography will increase, causing possible alterations in life cycles of such species as cranes, eagles, Sage Grouse (on the leks), etc.	Initiate research to locate unusual species populations and habitats on potential development areas. Cooperate with agencies and research institutions in protecting known threatened or endangered species locations. Cooperate in possible re-introduction programs or recovery. (*)
	Design public awareness programs relative to laws, regulations, ecological sensitivity of certain areas, and area research programs and sites. (*)
	Assist RMBL in developing and implementing research site protection plans. (*)
Impacts related to increased human population, housing-service developments, birdwatchers, photographers may have impact on Sage Grouse leks. Ohio Creek leks are on private land which could be developed for housing.	Protect lek areas based on CDOW management plans.
	Consider lek areas when purchasing lands for trade.
	Attempt to create new leks on public lands on south and west sides of Flat Top. (*)
Increased human presence in the Iron Bog for research purposes, curiosity, or collection of unusual plant species	Protect the Bog from disturbance by equipment. (*)
	Minimize dust through watering, petrocohesions or other techniques. (*)
	Include Kebler Pass Road in dust control program, or pave all major Project access roads (*)
	Limit research and intrusive activities and implement a bog protection and management plan. (*)
Impacts related to activities in wetland areas i.e., tailing disposal, facilities constuction.	Place wetlands into public domain via forest exchange. Develop reservoirs for the aquatic/wildlife habitat and recreation.
Damage to sensitive vegetation by transmission line construction	Remove and replace intact "pads" of vegetation around tower foundations. (*)
	Use articulated equipment with ground pressures less than 10 psi. (*)
	Use helicopters for construction or location of towers. (*)
	Establish pull sites at areas accessible by existing roads. (*)
Sediment deposition damaging the sundew plants.	Install sediment diversions between upslope fills and the Iron Bog. (*)

Table B-2 WILDLIFE MITIGATION MEASURES

Impact	Mitigation
Habitat destruction and alteration	Minimize land area disturbed for construction, particularly important habitats. (*)
	Leave areas of natural habitat in and around facilities where practical. (*)
	Design facilities and construction activities around riparian, wetland areas, and aspen stands where practical. (*)
	Develop springs and ponds on lands not being used for construction and plant with willows and cottonwoods. (*)
	Create or reconstruct aspen woodlands and riparian or wetland areas. (*)
	To the extent feasible, essential wildlife habitat such as ptarmigan winter areas and sage grouse strutting ares, will be avoided. (*)
	To the extend feasible, roads and other transportation facilities will be located away from the edge between two vegetative types, so that the "edge effect" can be maintained for wildlife. (*)
	Short snags and dead or dying trees used by cavity dwelling wildlife will be left within rights-of-way wherever possible. (*)
Increased population will place increased pressure on existing habitats in project area and the County to a lesser degree	Protect or acquire habitats of special importance or high sensitivity (e.g., critical winter range, Sage Grouse breeding grounds, colonial bird nesting sites, riparian habitat, etc.). Consider important wildlife habitats in land purchases for trade (aspen woodlands, riparian areas, wetlands, winter range and alpine areas). (*)
	Restrict ORV use on other than maintained roads on AMAX properties.
Potential contamination of adjacent habitats by fugitive dust.	Keep ore moist, if practical, when in the open to control fugitive dust. (*)
	Monitor molybdenum levels in soils and vegetation in adjacent habitats. (*)
	Utilize water erosion and dust controls. Dike all oil, diesel fuel, and similar storage areas. (*)

Table B-2 (continued)

Impact	Mitigation
Mobile species will be displaced into adjacent habitats which may cause increased stress to habitats and populations resident to those habitats. Species displacement also may change species composition, diversity, and abundance in adjacent habitats	Increase productivity, food, and cover value in habitats adjacent to construction areas. Habitat manipulation techniques including planting of high value food species and fertilization may be employed. (*)
Increased noise (particularly blasting), fugitive dust, and human presence may disrupt critical life-cycles such as breeding, nesting, brooding, roosting, young-rearing, migrations, predator-prey relationships, etc.	Reduce blasting to the extent practical during crucial periods such as night, dawn, and dusk, and during May and June for calving areas and December through March on big game winter range areas. (*) Insofar as practical, conduct blasting activities at same time (daily or weekly) to allow animals the chance to adapt to a more regular schedule. (*) Control fugitive dust. (*) Discourage off-road travel in habitats adjacent to construction activities during the main bird breeding/nesting period of mid-May through mid-June. (*) Construction activities will not disturb crucial wildlife habitat areas during critical periods. These determinations will be made on a site-by-site basis. The dates are: deer and elk winter range, November 1 to May 31; elk calving areas, May 15 to June 15; sage grouse strutting and nesting areas, April 15 to June 30; raptor nesting and rearing areas, March 1 to June 30; ptarmigan wintering areas, October 1 to May 31; Brown trout spawning and hatching areas, November 1 to February 15; Brook trout spawning and hatching areas, September to December 31. (*) Conduct educational programs to sensitize employees to the need for minimizing disturbance. (*) Develop and implement a comprehensive wildlife management and access program (*)
Impacts on big game habitat, populations, and life cycles from construction, operation, and increased direct and indirect human activity.	(Most mitigation is similar to preceding wildlife mitigations.) Purchase of winter range areas on private lands for trade to agencies, the Nature Conservancy, or to manage as winter range. Post wildlife informational warning signs on AMAX property. Collecting of any wildlife will be prohibited on AMAX property.

Table B-2 (continued)

Impact	Mitigation
Impacts on big game habitat, populations, and life cycles from construction, operation and increased direct and indirect human activity. (continued)	Implement and enforce a strict leash law or control ordinance for domestic pets. Firearms will be prohibited on AMAX property except under special permit. Increase productivity of existing winter range areas through fertilization and/or range improvement programs. (*) AMAX will Assist CDOW in emergency winter feeding programs should the need arise. Railroad and access roads will be unfenced or, at most, fenced only with low stock fences. (*) Restrict blasting to a regular daylight schedule. (*) Maintain aspen "fingers" used as movement routes. (*) Minimized disturbance areas. (*) Natural vegetation in lower Alkali Creek streambed will be maintained where practical. (*) When and where practical, activities will be reduced during periods of darkness in May, November, and early December. (*) Design access roads for good visibility and post low speed limits. (*) Employee training programs will include information relative to wildlife laws, regulations, and management programs, location of road kill areas, need for wintering animals to be undisturbed. Design shift changes away from periods of dawn and dusk when practical. Support wildlife research programs and projects. Increase security patrols on AMAX property during movement period and hunting seasons. Restrict or control use of firearms on AMAX property. Control access onto or through AMAX properties (to public lands) in accordance with safety requirements and recommendations of CDOW and U.S. Forest Service.

Table B-2 (continued)

Impact	Mitigation
Impacts on big game habitat, populations, and life cycles from construction, operation and increased direct and indirect human activity. (continued)	With Colorado Highway Department approval, improve and widen Colorado Highway 135 from Almont to Jack's Cabin.
	Reduce speed limits along high risk stretches during period when risk is highest (usually winter or winter range areas). Post high visibility warnings near known crossings.
Increased presence of humans will increase pressure on huntable species, increase the risk of vehicle-wildlife collisions, increase the chance human-wildlife conflicts, increase the incidence of collecting (reptiles, amphibians, bird nests, etc.) by humans. Increase in domestic pets (cats and dogs) will increase the likelihood of wildlife being killed or harassed.	Increase in enforcement work by CDOW and USFS. (*)
	Implement public awareness programs to: 1) the sensitivity of wildlife; 2) warn the public of disease potential, particularly concerning rodents; 3) warn the public against feeding wildlife, leaving refuse in the open, and approaching wildlife for observation. (*)
Noise intrusions during construction of Alkali Basin facilities could cause minor disturbance of eagles roosting along East River	Minimize blasting during late evening and night when wintering eagles are present.
Increased housing development in cottonwood bottom and roost areas and increased disturbance by humans	Implement employee awareness programs.
	Protect the area from unnecessary human intrusion.
Increased human populations may increase pressure on remote areas and sensitive areas such as alpine systems, research sites, etc. Activities such as bird-watching and wildlife photography will increase, causing possible alterations in life cycles of such species as cranes, eagles, Sage Grouse (on the leks), etc.	Initiate research to locate unusual species populations and habitats on potential development areas. Cooperate with agencies and research institutions in protecting known threatened or endangered species locations. Cooperate in possible re-introduction programs or recovery. (*)
	Design public awareness programs relative to laws, regulations, ecological sensitivity of certain areas, and area research programs and sites. (*)
	Assist RMBL in developing and implementing research site protection plans.
Impacts related to increased human population, housing-service developments, birdwatchers, photographers may have impact on Sage Grouse leks. Ohio Creek leks are on private land which could be developed for housing.	Protect lek areas based on CDOW management plans. (*)
	Consider lek areas when purchasing lands for trade.
	Attempt to create new leks on public lands on south and west sides of Flat Top. (*)

Table B-2 (continued)

Impact	Mitigation
Potential water quality impacts to the Roaring Judy Trout Hatchery (Alternatives 2-4)	Subsurface strata dip to the west away from the hatchery. Ground water will accordingly move westward. Dams will be keyed into bedrock with grout curtains through shallow surficial materials. Natural run-off will be routed around the tailing system. State-of-the-art erosion control, settling basins, and reclamation will be applied to minimize potential for sedimentation.

Table B-3 AQUATIC ECOLOGY MITIGATION MEASURES

Impact	Mitigation
	(Most mitigations are similar to water resource mitigations that follow this table.)
Habitat alteration including stream bank disruption and increased sedimentation during construction-causing temporary reduction in spawning success and reduction in habitat of fish food, especially benthic invertebrates	Design and construct roads and crossings to minimize encroachment into stream channel and so as to not block fish movement. (*) Minimize erosion and utilize erosion controls during construction; time construction to avoid, where practical, activities during spawning seasons. (*)
Increased fishing pressure due to population increases	Treatment of Keystone mine water will enhance the opportunity to improve Coal Creek and Slate River water quality. Restore and enhance lower Coal Creek fishery habitat. (*) AMAX will participate with Trout Unlimited in stream improvement projects in the area. Open AMAX properties to public fishing in coordination with CDOW programs and cooperation with Trout Unlimited.
Increased nutrient and suspended soils loading to streams as a result of increases in discharge from public domestic waste treatment facilities	Encourage compliance with standards and increase capacity of public waste water treatment facilities. (*) Encourage regional 201 wastewater study.
Pollution of receiving streams from accidental spills of oil diesel fuel, or other supplies.	Establish emergency contingency program for accidental spills; dike all oil, diesel fuel, and similar storage areas.
Interference with the maintenance of favorable conditions of flow.	Regulate reservoir releases in such a way that favorable conditions of flow are maintained year-round. (*)

TABLE B-4 ENERGY CONSERVATION

Impacts	Mitigation
Increases in local energy conservation	Incorporate energy conserving requirements into local building codes. Use carpooling or bussing to encourage energy conservation. Avoid unnecessarily long electrical transmission lines. Avoid unnecessary hoisting of ore and pumping of water. Use life cycle costing.

Table B-5 WATER MITIGATION MEASURES

Impact	Mitigation
Decreased surface water quality	Operate with no discharge of process water. Locate milling facilities so that any spills are tributary to the tailing pond. (*) Revegetate disturbed areas as quickly as possible. Grade unpaved roads and minimize vehicle traffic, particularly during spring snowmelt. Intercept and divert erosion sediment into settling basins. Work in stream channels only during periods of low flow. Construct culverts to divert runoff of natural drainages. Route surface runoff away from construction areas. Uses water bars, rip rap, gabions and other erosion controls. (*) Maintain graded roads, bypass ditches, and culverts. (*) Control fugitive dust emissions. (*) Dike all oil, diesel fuel, and similar storage areas; establish emergency contingency program for accidental spills; use oil skimmers and separators on settling ponds. (*) Pipe mine water to mill, or treat at heavy metals water treatment plant before discharge. (*) Treat domestic wastes from mill and discharge to tailing pond. (*)

Table B-5 (continued)

Impact	Mitigation
Decrease surface water quality (continued)	Dispose of waste sludges at designated sites. (*)
	Provide tertiary treatment of domestic wastes before discharge and use an acceptable method of sludge disposal at the mine site. (*)
	Conduct operations such that debris does not enter streamcourses. (*)
	Artificial drainages (including ditches) Design to reconnect with existing drainages only after: surface spreading, passage through settling basins, or other treatment designed to remove the bulk of sediment entrained in the artificial drainage. (*)
	Avoid artificial drainages collect several small-order streams and concentrate them in a channel that cannot handle the extra flow. (*)
	Install culverts or bridges where it is necessary to cross streamcourses. If feasible, protect the integrity of stream bottoms where a fishery exists. (*)
Surface-water flow changes	Minimize disturbed areas and revegetate as soon as practical. (*)
	Regulate reservoir releases in such a way that favorable conditions of flow are maintained. (*)
	Obtain mill make-up water from large flow sources during spring runoff periods, if possible. Divert water during other periods when water is physically legally available. Recycle treated waters for reuse.
	Intercept surface flows above, divert around, and discharge downstream of tailing disposal area. (*)
Decreased ground water quality	Construct tailing dam with impervious core to prevent seepage into surficial geologic units. (*)
	Favor tailing disposal areas with low subsurface permeability and the natural ability to neutralize tailing seepage.
	Employ controlled management of ground water, minimizing flow through mobilized zones and the mine-extraction area. Combine favorable aspects of such mitigation techniques as: 1) adit seals with grouting of faults; 2) slurry discharge/inject into the rubble; 3) decant system with drains and new technology.

Table B-5 (continued)

Impact	Mitigation
Potential disruption of Town of Crested Butte's domestic water supply	In cooperation with the Town of Crested Butte, relocate and improve water supply by moving source to Slate River and constructing well system. Improve the Town's water treatment system (Alternatives 2, 3 and 7) Move the intake above the fill. (*) Move the fill below the intake. (*) Build trestle or bridge. (Alternative 7) (*)

Table B-6 AIR QUALITY MITIGATION MEASURES

Impact	Mitigation
Point source emissions at the mill	Use scrubbers or dust collectors. Use low sulfur coal. Use multi-stage feed for incinerator.
Fugitive dust emissions in the mill-tailing area	Partially enclose or contain emergency coal storage pile; apply tackifier to surface. Use water sprays during scraper operations. Revegetate disturbed areas as soon as practical. Pave major access roads, service roads, and parking lots. (*) Place water and adhesive binder on unpaved roads. (*) Provide vehicle washes and mud carryout prevention facilities. Maintain water pool on tailing pond. (*) Use adhesive binder or wetting procedures on tailing beach area. Revegetate tailing dam face as soon as practical. (*)
Point source emissions within the underground mine	Use catalytic scrubbers on all underground diesel equipment. Use water sprays at underground draw points Use dust collectors at underground loading points.

Table B-6 (continued)

Impact	Mitigation
Point source emissions within the underground mine (continued)	Use low velocity airflow along with high humidity underground.
Point source emissions at the mine site	Use high efficiency lime venturi scrubber on boiler. Use low sulfur coal. Use scrubbers or equivalent dust collectors Use multi-stage feed for incinerator.
Fugitive dust emissions at the mine site	Partially enclose or contain emergency coal storage pile; apply tackifier to surface. Use water sprays during scraper operations. Pave major access roads, in-plant roads and parking lots. (*) Revegetate disturbed surfaces as soon practical. (*) Place water and adhesive binder on unpaved roads. (*)
Increase in vehicle emissions along Project access routes	Investigate use of mass transportation. Use measures such as car or van pooling and busing of employees. Schedule shift changes to avoid peak traffic periods.
Increase in secondary emissions	Develop land use planning regulations. Implement air quality computer programs and possibly emission control regulations.

Table B-7 NOISE MITIGATION MEASURES

Impact	Mitigation
General construction noise	If practical, confine surface construction to daytime hours. (*)
	Ensure that all diesel equipment has operational exhaust mufflers. (*)
Blasting noise	Perform sonic tests to ensure atmospheric conditions are suitable for surface blasting.
(*)	Limit surface blasting to daytime hours.
Operational mine site noise	General activity - ensure operational mufflers on all above ground diesel equipment. (*)
	Ventiliation system - reduce intake and exhaust fan noise by use of specially designed housings. (*)
	Onsite vehicle noise - enforce maximum onsite speed limits.
Operational mill-tailing area noise	Crushing facilities - use noise silencers on building ventilation systems.
	Dust collection system - use noise silencers for noise from dust collectors.
	Onsite vehicle noise - enforce maximum onsite speed limit.
Operational ore haulage system noise	Wheel/rail noise - perform regular wheel and rail maintenance to avoid wheel flats.
	Avoid routine use of locomotive horns or whistles, except where required by government regulation.(*)
Vehicle noise at specific residences	Consider road realignment, use of earth berm barriers and depressed roadways.
Vehicle noise in the community	Encourage car pooling and restrict truck deliveries to daytime hours, if necessary.

Table B-8 CULTURAL RESOURCE MITIGATION MEASURES

Impact	Mitigation
National Register Eligible Sites - aboriginal - which will be directly disturbed	Total surface collection and partial or complete excavation of the site and analysis of the contents. (*)
National Register Eligible Sites - Euro-American - which will be directly disturbed	Buildings with standing architecture will be mapped, sketched, photographed, and a history search will be conducted. (*) Partially excavate ancillary trash deposits. (*)
Sites that will not be disturbed	Avoid site disturbance. Protect National Register Eligible sites through security patrols, fencing, etc. (*)
Unauthorized collection of artifacts and site vandalism	Conduct awareness program relative to significance of heritage resources and laws and regulations governing site protection. (*)
Indirect heritage resources	Encourage owners to record and protect structures and sites.
Damage to sites not yet identified	Conduct an archaeological inventory at AMAX's cost prior to clearing in order to locate, evaluate, and mitigate impacts to archaeological resources. Excavations will be performed according to the Uniform Rules and Regulations of the Secretaries of Agriculture, Interior, and Defense that pertain to the excavation of archaeological sites. The responsible Federal Agencies shall continue the procedures for determination of eligibility and effects as specified in 36 CFR part 800. For eligible properties determined to be adversely affected, a Memorandum of Agreement will be prepared in acccordance with 36 CFR 800.6c. (*) If during excavation work, items of substantial archeological or paleontological value are discovered, or a known deposit of such items is disturbed, cease excavation in the area so affected. On NFS land notify the Forest Service and do not resume excavation until written approval is given. (*)

Table B-9 VISUAL RESOURCE MITIGATION MEASURES

Impact	Mitigation
Mine and mill areas change visual quality	Follow existing vegetative patterns when clearing areas (i.e., do not create linear or rectangular openings); retain natural topographic features where practical. (*)
	Retain as many stands of existing vegetation as practical; site facilities to fit existing vegetation openings instead of creating new ones; fit parking lots, storage areas, and buildings into vegetation where practical. (*)
	Place major parking lots and equipment storage areas behind screening berms, vegetation, or buildings; retain patches of shrubs and trees throughout, if possible. (*)
	Revegetate all areas as soon as practical with species native or adapted to the particular plant community disturbed. Do not plant species which may conflict structurally with the existing plant community (e.g., trees into sagebrush areas, etc.). (*)
	Develop berms where practical as extensions of natural topography; revegetate berms with compatible species. (*)
	Design (color and shape) facilities to be compatible and blend with existing landscape, where practical. (*)
	Control emissions and fugitive dust. (*)
	Limit nighttime lighting to what is necessary; shield from view. (*)
	Retain cottonwoods along Colorado Highway 135 to screen the site from view; reduce clearing of aspen to minimum. Preserve the aspen fingers on the south side of Red Mountain. (*) (Alternatives 2-4)
Long-term changes in visual quality	Dismantle unnecessary structures following operations. (*)
	Revegetate disturbed areas as soon as practical. (*)
Roads and ore haulage system change visual quality	Construct all roads and railroads to follow the contour of the land as much as be practical. (*)
	Minimize number of roads. (*)

Table B-9 (continued)

Impact	Mitigation
Roads and ore haulage system change visual quality (continued)	Use fill materials (at least the surface of the fill) that are of a color similar to local materials, as practical. (*) Use natural landform and vegetation to screen roads where applicable. (*) Design overhead power structures for the ore haulage railroad to be compatible with local landscape, if practical. (*)
Power lines change visual quality	Screen powerline tower sites from view if possible. Locate powerlines behind ridges and out of view of travel routes, towns, residences, and recreational centers. Where this cannot be done, keep towers and conductors beneath the skyline and against a backdrop of hills or ridges. Avoid sidehills, narrow ridges, and small hilltops for tower sites. Use nonspecular wire and flat paint. Design major road and highway crossings for minimum visual impact by crossing between high points, at dips, or on curves to avoid long views of the line. Utilize long spans at crossings. Use natural screening and land features for maximum concealment. Cross major roads at right angles. (*)

TABLE B-10 OUTDOOR RECREATION MITIGATION MEASURES

Impact	Mitigation
Crowding at the Swampy Pass trailhead accessing the West Elk Wilderness area	Enlarge the trailhead area. (*)
Increasing frustration from users at the Lake Irwin area having difficulties driving through the outlet spillway	Build a bridge. (*)
Conflicts between competing recreation uses	Intensify recreation management programs. (*)

TABLE B-11 WILDLAND FIRE MITIGATION MEASURES

Impact	Mitigation
Increased numbers of fires	Initiate more aggressive public man-caused information programs. (*)
	Initiate more aggressive law enforcement programs. (*)
	Monitor contract activities to ensure fire prevention measures are followed (*)
	Provide public services such as chainsaw inspections. (*)
(*)	Manage firewood areas to minimize risks.
	Maintain a muffler or spark arrester satisfactory for the exhausts of all trucks and tractors or other internal combustion engines used in connection with project activities. (*)
	Prepare a fire plan which will set forth in detail the plan for prevention, control, and extinguishing of fires on the project and associated areas and within areas of responsibility. Such plans shall be jointly reviewed and revised at intervals of not less than three years. (*)

TABLE B-12 TRANSPORTATION MITIGATION MEASURES

Impact	Mitigation
Increased traffic volumes will reduce the level of service of arterial roads during peak times and increase vehicle accidents.	Initiate carpooling and or bussing programs
	Establish shift start/end times to avoid other peak hours on arterial access roads
	Reconstruct highway 135 to provide a uniform service level C and possibly a truck climbing lane (Alternatives 3-6)
	Widen the intersection where the mill access road joins the arterial highway to provide acceleration, deceleration, and left turn lanes
	Provide minimal parking at the mine
	Reconstruct the intersection of Colorado 135 and the Ohio Creek Road to permit safer turning
Increased heavy truck traffic will accelerate road surface deterioration.	Initiate agreements with AMAX to repair or rebuild on an annual basis and at the conclusion of construction (*)

TABLE B-13 SOCIOECONOMIC MITIGATION MEASURES

Impact	Mitigation
Residents become alienated and socially isolated due to perceived differences, leading to a number of social problems and breakdown of systems	Fully support and officially sanction the Human Services Council of the Gunnison Region, Inc. Provide information to civic groups and other audiences concerning Mt. Emmons and the changes expected to occur. Establish an impact communications center to provide media and residents with factual information. Plan and implement a county-wide newcomer integration program. Initiate creative funding of social services organizations. Provide for anticipatory staffing and resource levels.
Increasing demands for general government services	Expand staffs and space, as needed. Initiate funding and proceed with expansion of library facilities.
Increasing demands for health services	Carry out the hospital's four-phase expansion plan to coincide with population growth. Form a hospital district to provide an independent administration and legal vehicle for financing hospital improvements.
Increased demands for local government funds leading to higher taxes, or deteriorating services	Require growth to pay its own way to the maximum degree possible. Levy a County-wide use tax to tap energy/mineral development for front-end funds. Raise sales and use taxes before development starts so that growth can help with early financial needs.
Demands for increased recreational space and diversity causing crowding of existing facilities	Develop a countywide master plan for parks and recreation. Form a special metropolitan recreation park district. Provide a park with active facilities in conjunction with a construction worker camp
Increased fire protection needs	Expand fire protection systems as needed. Consolidate fire districts.

Table B-13 (continued)

Impact	Mitigation
Increased fire protection needs (continued)	Increase emphasis on planning, code enforcement and inspection during construction.
	Ensure that if new building designs or site plans that are approved necessitating a new type of equipment or training, the required items will be available.
	Develop a financial plan that will achieve the level of service needed.
	Cross train law enforcment officers in basic fire protection.
Rapid acceleration of crime rates	Increase numbers of trained staff commensurate with needs.
	Establish salary levels for law enforcement personnel competitive with industry and metropolitan areas.
	Provide attractive fringe benefits for law enforcement employees.
	Institute stress reduction programs.
	Initiate countywide law enforcement planning.
	Develop a crisis intervention team.
	Develop a holding cell for the Crested Butte/Mt. Crested Butte area.
	Expand County Jail facilities between 1985-1990.
	Schedule work to allow workers to commute to metropolitan areas on weekends.
Increased capital investment to customer ratios for local utilities, leading to large increases in rates	AMAX pays for project's transmission lines
	Utilities participate in review of major land development proposals to minimize costs of extensions.
	Institute a plant investment fee to require new customers to pay for their share of the physical system.
	Form an inter-utility coordination committee for planning and coordinating utility service area expansions.
Shortfalls in wastewater treatment facilities	Complete sub-regional 201 plans.
	Develop facility plans as soon as sub-regional plans are completed.

Table B-13 (continued)

Impact	Mitigation
Shortfalls in Municipal water supplies	Obtain new water rights as new development occurs.
	Protect water sources from potential point and non-point pollution.
	Structure rates to fully finance water systems.
Increases in primary and secondary students	Increase the number of students per classroom.
	Initiate split sessions.
	Provide additional facilities.
	Coordinate classroom use with Western State College.
	Include school land dedication provisions in land use regulations.
Housing shortages	Review master plans and include plans to accommodate townhouses, apartments, and mobile homes.
	Develop standards to insure quality construction.
	Use construction worker housing, when available, for student housing.
	Design incentive programs that will generate housing construction.
	Maintain advocacy groups for financial assistance programs.
	Require low income set-aside units in new developments.
	Provide worker housing and recreation facilities for short term workers.
	Develop cooperative housing for senior citizens.
Inadequate solid waste disposal systems	Acquire adequate land for a disposal site to serve entire county's needs through at least the year 2000.
	Consider public land sites which require no acquisition costs.
	Consider a phased land purchase/lease option over a 20-30 year period.

Table B-14 GEOLOGICAL HAZARDS MITIGATION MEASURES

Impact	Mitigation
Increased slope instability and reactivation of landslides	Incorporate avoidance of unstable areas in project design. (*) Improve drainage in areas of slope instability. (*) Maintain or decrease ground water levels where applicable. (*) Install retaining structures. (*) Remove peat and other compressible organic materials. (*)
Increased rock falls	Route and locate facilities to avoid rockfall areas. (*)
Slope instability at tailing pond area during and after operation	Tailing will buttress slopes. Improve drainage in tailing area with diversion structures. (*)
Tailing dam stability	Route area runoff around pond for probable maximum flood. (*) Use earth-fill dam and revegetate as soon as practical. (*) Revegetate tailing surface after project closure. (*)
Subsidence	Limit access to the potential area of subsidence during operations and actual area of subsidence after project closure. (*) Use a room-and-pillar mining technique.
Disruption of natural topography and contours in areas of surface facilities	Recontour areas of disturbance to blend with surrounding area. (*)

Table B-15 SOILS MITIGATION MEASURES

Impact	Mitigation
Soil disruption during stripping, stockpiling, and redressing	Minimize disturbance time and areal extent of disturbed soils. (*)
	Schedule disturbance to coincide with periods when soils are dry, especially in clayey soils. (*)
	Minimize traffic and exposure of subsoil materials during construction. (*)
Soil Compaction	Minimize off-road traffic and soil handling. (*)
	Use low ground-pressure equipment for reclamation. (*)
Increased soil instability including soil creep and slumping	Stabilize unstable slopes as soon as practical. (*)
	Minimize traffic on steep slopes. (*)
	Implement erosion and runoff control measures as soon as practical. (*)
	Avoid cuts through talus slopes. (*)
Soil erosion and sedimentation	Minimize slope length with contouring, ditches, or terraces. (*)
	Avoid prolonged exposure of soils with high erodibility factors. (*)
	Avoid disturbance of steep slopes. (*)
	Revegetate as soon as practical. (*)
	Control runoff early erosion with mulch, rip rap, etc. (*)
	Use rip rap for stream bank stabilization. (*)
	Salvage soils of wet areas or drainages for redressing on similar areas. (*)
	Avoid excessively cobbly or bouldery areas during topsoil stripping. (*)
Decreased soil productivity	Minimize handling during stripping and stockpiling. (*)
	Utilize N-fixing legumes and soil innoculation. (*)
	Revegetate as soon as practical. (*)
	Carry out reclamation plan. (Table B-1)(*)

TABLE B-16 LAND USE MITIGATION MEASURES

Impact	Mitigation
Increasing demands for additional land to convert to urban uses	Assure that the infrastructure of services is in place, so housing can be constructed to fit within community goals.
	Assure that codes, regulations, planning and policies are effective in controlling the spread of new development so that it does not become a threat to agriculture.
Interference with other permitted uses	If lands are exchanged, or special-use permits are issued, the rights of all existing permitted uses will be honored. (*)
	No fences shall be erected or gates locked upon NFS lands, except by written permission of the authorized official. (*)
Interference with other developments and structures	AMAX and its contractors will not use any existing developed water sources on federally-owned lands without written permission from the agency with jurisdiction. (*)
	Damage to existing range improvements and structures will be immediately repaired or paid for as required by the owner. (*)
	If a barrier used for livestock control is broken or destroyed, the gap thus opened will be fenced to control the drift of livestock. On Federally-owned lands these fences will be built to required specifications. Cattleguards will be installed as required. (*)
	Existing road access will be maintained. It may be rerouted if approved by the authorized representative of the land owner. (*)
	AMAX will pay the United States (or its permittees) full value for all damage to land improvements or other property of the United States (or its permittees) caused by AMAX or its contractors. (*)
Unwanted access	Project-related vehicle traffic will be restricted to designated routes. (*)
	New public access, as well as improved public access, will not be created unless specifically approved by the authorized representative of the land owner. (*)
Unwanted roads	Sock lines will not be strung by driving along the transmission line right-of-way. (*)

Table B-17 AVALANCHE HAZARD MITIGATION MEASURES

Impact	Mitigation
Accidental extension of active avalanche period during mine operation due to blasting and subsidence	Design and conduct avalanche forecasting program. (*)
Increased exposure of population and employees to avalanches	Locate facilities and roads in low avalanche hazard areas. (*) Prohibit skiing on Mount Emmons after operations begin. (*)

TABLE B-18 OTHER MITIGATION MEASURES

Impacts	Mitigation
Unanticipated disturbances	Do not undertake surface disturbing activities on NFS lands until a construction plan has been approved by the Forest Service. The plan shall include: detailed designs of the planned activities; schedules and sequencing; equipment to be used; planned environmental mitigations; and an analysis of the environmental impacts anticipated. (*) All modifications or additions to the Plan of Operations must be approved by the Forest Service before surface disturbances related to the changes can begin. (*) Regularly inspect activities to insure compliance with required mitigation measures. (*) Hold meetings with the federal agency having jurisdiction over an activity prior to the commencement of surface disturbance to insure that the agency's guidelines and requirements are understood by AMAX and its contractors. (*) AMAX's contactors and employees abide by the "Rules of Conduct" as listed in 36 CFR 261.4 when working on National Forest System lands. (*)
Lack of public awareness regarding year-by-year project activities	Regularly announce upcoming activities. (*)
Local site-specific conflicts with land use direction set by the East River Unit Land Management Plan (Forest Service, 1979c).	Adjust site-specific land use direction as a part of the Forest Land Management planning process. Continue with compatible land uses as applicable. (*)

Table B-18 (continued)

Impact	Mitigation
Inductive interference with other communication facilities	Make provision or bear the reasonable cost of making provision for avoiding inductive interference between any project transmission line or other project work constructed, operated, or maintained under special use permit, and any radio installation, telephone line, or other communication facility installed or constructed before construction of such project transmission line or other project work, and owned, operated or used by the Forest Service in administering the National Forest and land under its jurisdiction. The foregoing provisions shall also relate to any radio installation, telephone line, or other communication facility installed or constructed by the United States after construction of such project transmission line or other project work. (*)
Unwanted electrical charges	All fences, gates, cattleguards, trailers, or other objects or structures that could become inadvertently charged with electricity, shall be grounded. (*)
Hazards to public health and safety	Carry on all operations in a workmanlike manner having due regard for the safety of employees; and shall safeguard with fences, barriers, fills, covers, or other effective devices, pits, cuts, and other excavations which otherwise would unduly imperil the life, safety, or property of other persons. (*)
	Perform work with explosives in such a manner as not to endanger life or property. All storage places for explosives and flammable material shall be marked "DANGEROUS." The method of storing and handling explosives and flammable materials shall conform to recommended procedures contained in the "Blasters Handbook," published by E.I. du Pont de Nemours & CO., and in all Federal, State, and local laws and regulations. (*)
	Design and construct in accordance with accepted standards and specifications for transmission lines of similar voltage, capacity, and purpose. Place and maintain suitable structures and devices to reduce to a reasonable degree the liability of contact between the powerline and telegraph, telephone, signal, or other powerlines heretofore constructed. Place and maintain suitable structures and devices to reduce to a reasonable degree the liability of any structures or wires falling and obstructing traffic or endangering life on highways or roads. (*)

Appendix C. Project Layout Details

APPENDIX C: PROJECT LAYOUT DETAILS

MINE SITE

The mine site supports access to the mine's underground workings. Men and equipment enter the mine from it. Change rooms, repair shops, and various storage facilities are located there. Table C-1 lists the structures likely to be built. Coal-fired boilers are used to heat both the site's buildings and mine ventilation air. Ash from the boilers is hauled to the tailing disposal area for burial. The surface is paved or asphalted, and runoff from the site is treated to remove oil, grease, and sediment prior to release. A sewage treatment plant is included.

Coal Creek

This site is involved under Alternatives 2, 3, and 5-7.

The site (Figures C-1 and C-2) is located in the Coal Creek drainage at the lower end of Evans Basin. It is dominated by a main bench that holds most structures and consists of cut and fill material augmented by waste rock excavated during development of the mine's underground workings. Two smaller benches are also present: one for the water storage tanks, and one for the water treatment facilities.

Ventilation drifts enter the mine from this site. A more complete description of the site's facilities is in AMAX (1981a, Chapter 9).

TABLE C-1. MINE SITE STRUCTURES

1 - portal for men & supplies
2 - mine ventilation supply/heating
3 - compressor/electrical building
4 - mine office
5 - parking lot
6 - warehouse
7 - fuel storage
8 - service island
9 - gate house
10 - truck & ambulance storage
11 - concrete batch plant
12 - aggregate storage
13 - main electrical substation
14 - fire water storage tanks
15 - potable water storage tanks
16 - wastewater treatment plant
17 - timber framing shop
18 - mine exhaust
19 - boiler house
20 - change house
21 - core storage building
22 - maintenance shop
23 - mapp gas & cylinder storage
24 - oxygen & acetylene storage
25 - yard storage
26 - oil & grease storage
27 - scale house
28 - storage dock
29 - emergency coal storage
30 - sewage treatment plant
31 - powder magazine
32 - settling ponds
33 - incinerator
34 - interceptor system for surface drainage originiating upslope

(The above numbers correspond to those used in Figures C-2 and C-3.)

Slate River

This site (Figures C-1 and C-3) is involved in Alternative 4. It is taken from Stearns-Roger (1978a). It consists of one large bench constructed mostly of waste rock taken out of the access tunnel driven into the mining area. A small bench built upslope holds the water storage tanks.

Ventilation of the mine could be handled in two ways: (1) Ventilation drifts could be driven from the site. (2) Ventilation drifts or raises could be driven from some location in the Coal Creek drainage. This location could be near the site proposed by AMAX, or it could be elsewhere in the drainage but outside of the municipal watershed.

MILL SITE

The milling process extracts molybdenite from ore taken out of the mine. Additional metals may also be recovered as byproducts.

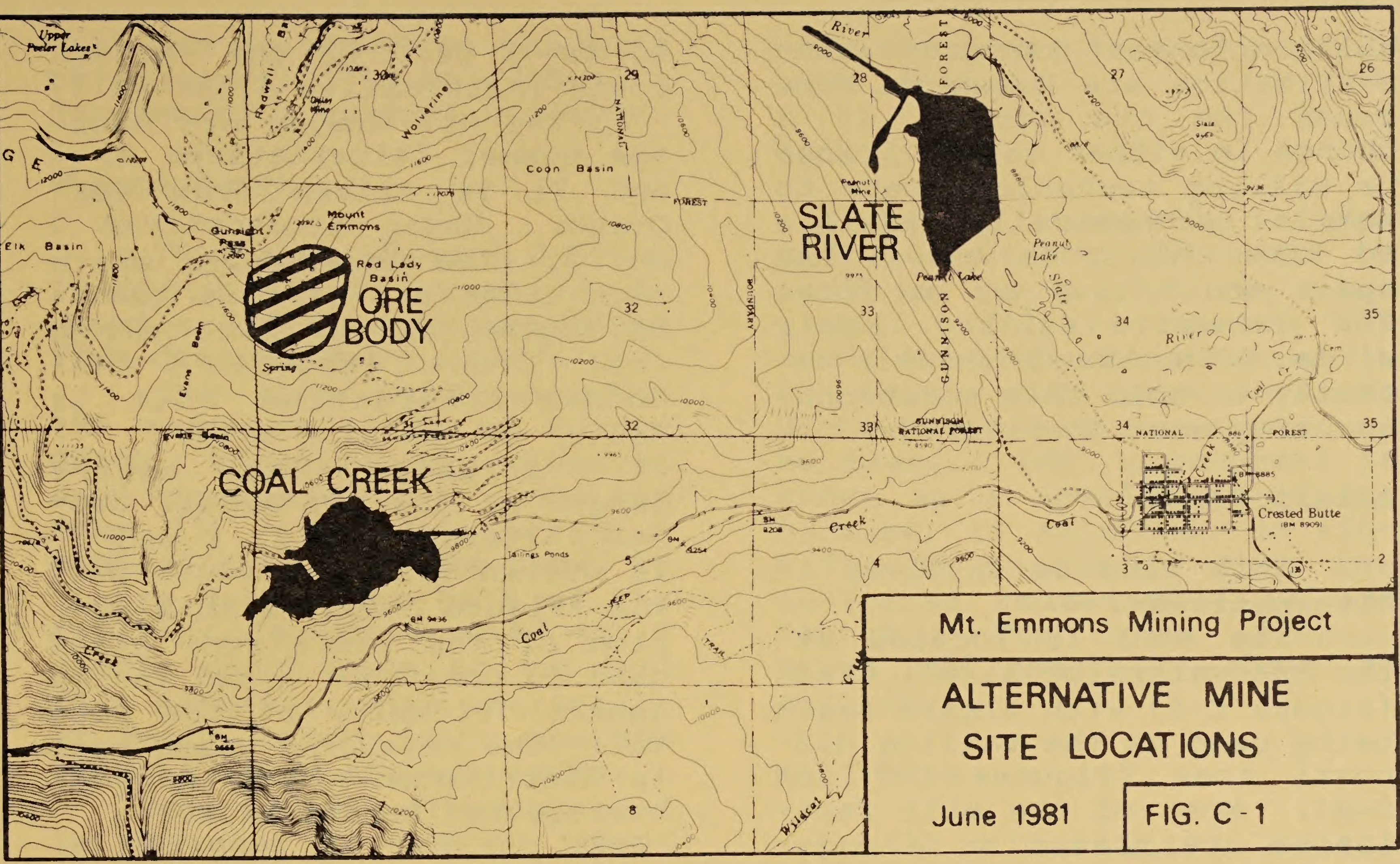
Through a series of stages, the ore is crushed into sand and the molybdenite is separated by flotation. Table C-2 contains a listing of the structures expected at the site. In addition, the following practices are employed:

- Coal-fired boilers are used to heat the mill buildings.
- Ash discharged from the boilers is placed in the tailing disposal area.
- The average annual consumptive use of water is 2,000-3,000 acre-feet.
- Water earmarked for use in the milling process is stored in a reservoir located below the tailing dam. The bulk of this water is ordinarily obtained during the spring runoff using water rights of sufficient seniority

TABLE C-2. MILL SITE STRUCTURES

1 - mill building (includes boiler)
2 - primary crushing plant
3 - electrical building and substation
4 - administration building
5 - gate house
6 - truck scale house
7 - mapp gas & cylinder storage
8 - bulk oxygen storage
9 - emergency coal storage
10 - transfer house
11 - ammonia & acid storage
12 - incinerator
13 - railroad shop (if rail haulage is used)
14 - topsoil stockpile
15 - coarse ore storage
16 - fine crushing plant
17 - sewage treatment plant
18 - parking area
19 - truck & ambulance garage
20 - oil, grease & fuel storage
21 - service pumps
22 - drive house
23 - transition house
24 - concentrate thickener
25 - nokes mix
26 - fire, mill and potable water storage tanks
27 - concrete batch plant

(The above numbers correspond to those used in Figures C-9, C-13 and C-16.)


Upper Peeler Lakes
Coon Basin
Mount Emmons
Red Lady Basin
Elk Basin
Gunsight Pass
ORE BODY
SLATE RIVER
Peanut Lake
COAL CREEK
Tailings Ponds
Coal Creek
River
Crested Butte
GUNNISON NATIONAL FOREST

Mt. Emmons Mining Project

ALTERNATIVE MINE SITE LOCATIONS

June 1981

FIG. C-1

to permit an adequate supply under conditions similar to the drought years of the mid-1950's.

- A flood bypass system capable of handling the 100-year flood is constructed around the tailing disposal area. This system generally discharges into the storage reservoir located below the main dam.

- The main dam is constructed to hold the probable maximum flood at any time during the life of the project.

- Major reagents used in the milling process and stored at the mill include: anhydrous ammonia, quicklime, Dowfroth 250, flocculant, sodium cyanide, hydrochloric acid, sodium hydroxide, phosphorus pentasulfide, sodium silicate glass, pine oil, and Syntex.

Also present near the mill site is the tailing disposal area. This is where the residue is placed once the molybdenite has been extracted, and it accounts for over 99 percent of the ore mined. Structures associated with the disposal system include: tailing dam, tailing pipeline, mill water reservoir, pump house, service roads, flood bypass system, seepage control system, and topsoil stockpile.

(AMAX proposes constructing the system to hold 180 million tons of tailing. It should be pointed out, though, that the three sites discussed below could each hold up to 300 million tons. This was a criterion established early in the Forest Service's selection process. The reason for this is that while the proven ore reserves of the Mt. Emmons deposit are about 155 million tons, more than another 100 million tons of low-grade mineralization are known to surround the ore zone. If a change in either market prices or milling technology were to make it economically feasible to take this rock also, then space would have to be found for the extra tailing. Only sites with the physical capacity to hold this additional quantity were considered.)

Alkali Creek

This site is involved in Alternatives 2-4.

The mill is located at the headwaters of Alkali Creek (Figure C-4) with Alkali Basin being used as the tailing disposal area (Figures C-7 and C-8). Most of the mill facilities are placed on a major bench shown in Figure C-9, with a small bench upslope to the north being used for water storage tanks.

The tailing deposit is stored behind an earth-fill dam with an impervious core anchored into the Mancos Shale bedrock to prevent seepage (Figure C-8). The tailing slurry is piped from the mill to the south side of the disposal area and discharged into it. Excess water is recovered on the north side of the basin and pumped back to the mill for reuse.

Two electric trains haul ore to the mill. Figure C-10 shows the typical appearance of this type of train. Each train consists of sixteen 100--ton ore cars making 9 trips a day at a maximum speed of 25 miles per hour. Eight trestles are proposed by AMAX for the western route (Alternatives 2 and 3). Trestles over suitable drainages are assumed to be a part of the eastern route (Alternative 4) as well.

The Mt. Emmons ore haulage tunnel (Alternatives 2, 3 and 7) is driven from Coal Creek. Under Alternatives 2 and 3, mine development waste rock taken out of this tunnel is deposited as fill along Coal Creek (Figure C-11). Undner Alternative 7 it is hauled to the mine site.

Virtually the entire length of the Mt. Axtell tunnel (Alternatives 2, 3 and 7) is driven from the south portal (Figure C-12), with a portion of the waste rock being used to construct a pad in the general vicinity of the portal. The remaining waste rock is distributed along the rail haulage bed to the mill.

Carbon Creek

This site (Figure C-5) is involved in Alternatives 5 and 6. Details of the site are taken from Stearns-Roger (1978b).

The area is located between Mt. Axtell and Carbon Creek, approximately 5 miles southeast of the Town of Crested Butte (Map 1). The details of a typical site plan for Alternative 5 are shown in Figure C-13, while the details for alternative 6 are shown in Figure C-14. The bulk of the facility is constructed on a single bench made of cut and fill material, with one smaller bench being built upslope to hold water storage tanks.

Tailing is impounded behind a conventional tailing dam similar to the types discussed in Soderberg and Busch (1977). Seepage in the downstream direction is collected and recycled back to the mill.

Ore is moved to the mill by conveyor. Figure C-15 is a drawing of a typical conveyor.

Chance Gulch

This site (Figure C-6) is involved in Alternative 7. Details of the site are taken from Stearns-Roger (1979a).

The site is located on the northeast side of Chance Gulch, approximately 5 miles east-southeast of Gunnison (Map 1). The details of a typical site plan are shown in Figure C-16. The bulk of the facility is constructed on a single bench made of cut and fill material, with one smaller bench being built upslope to hold water storage tanks.

The tailing disposal area is designed to prevent seepage. This requires installation of a clay liner under the tailing deposit, as well as an earth-fill dam with an impervious core. Two minor dams, at the east and west margins, are needed for containment at a maximum capacity of 300 million tons.

Haulage involves a unit train concept that involves two trains, each containing twenty-four 100-ton cars, and each making 6 trips per day at a maximum speed of 35 miles per hour.

WORKER ACCESS

Each of the components described above must be accesible by road. For the mine and mill, two reasonable modes of travel are possible: one is by individual vehicle, the other is by a combination of individual vehicle and mass transit, such as bus, carpool, and vanpool. There is no mass transit option for the other work sites.

Mine Site

Map 1 shows the alternative routes that could be used to reach the two mine sites. In all cases, the roads would be constructed in accordance with Colorado State Highway Class D standards and be paved. AMAX's proposal is shown as a specific location because, if selected, no significant variation from the indicated route would be expected. The other alternatives are generally shown as corridors.

Mill Site

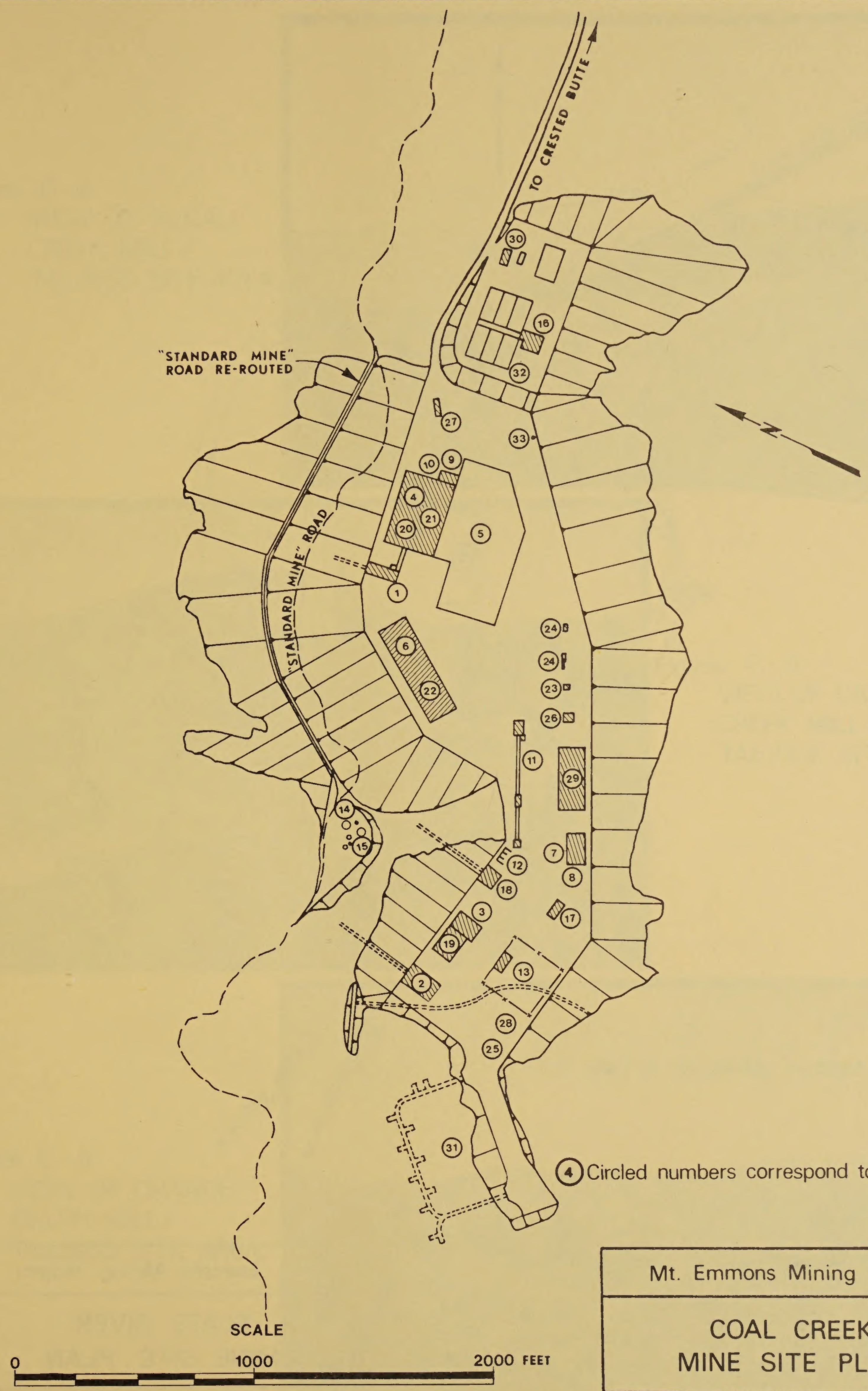
All alternative routes would be constructed in accordance with Colorado State Highway Class D standards and be paved. The Alkali Creek site could be reached by two routes (Map 1). AMAX's proposal would approach the mill from the east and is shown as a specific location. An alternative to this would approach the mill from the west. This is shown as a corridor. The Carbon Creek site could also be accessed by two routes (Map 1). Those portions of the routes that follow existing well-travelled roads are shown as specific locations because no significant relocations are expected, whereas these portions involving new construction are shown as corridors. Only one route is shown for Chance Gulch (Map 1).

Ore Haulage System

Worker access to haulage system facilities generally follows the routes themselves. However, AMAX proposes two exceptions:

(1) Access to the south portal of the Mt. Axtell tunnel would be via the Carbon Creek road, which would have to be reconstructed to a higher standard to permit the passage of heavy equipment used in driving the tunnel.

(2) Access to the Red Mountain tunnel may involve a spur between the reconstructed Carbon Creek road and the north portal of the tunnel. For the other rail haulage routes it is assumed that similar spurs would be built to facilitate access, but their locations cannot be ascertained at this time.


TO CRESTED BUTTE
"STANDARD MINE" ROAD RE-ROUTED
"STANDARD MINE" ROAD
N
30
16
32
27
33
10
9
4
21
20
5
1
24
24
23
26
6
22
11
29
14
15
7
8
12
18
17
3
19
13
2
28
25
31
SCALE
0
1000
2000 FEET

④ Circled numbers correspond to table C - 1

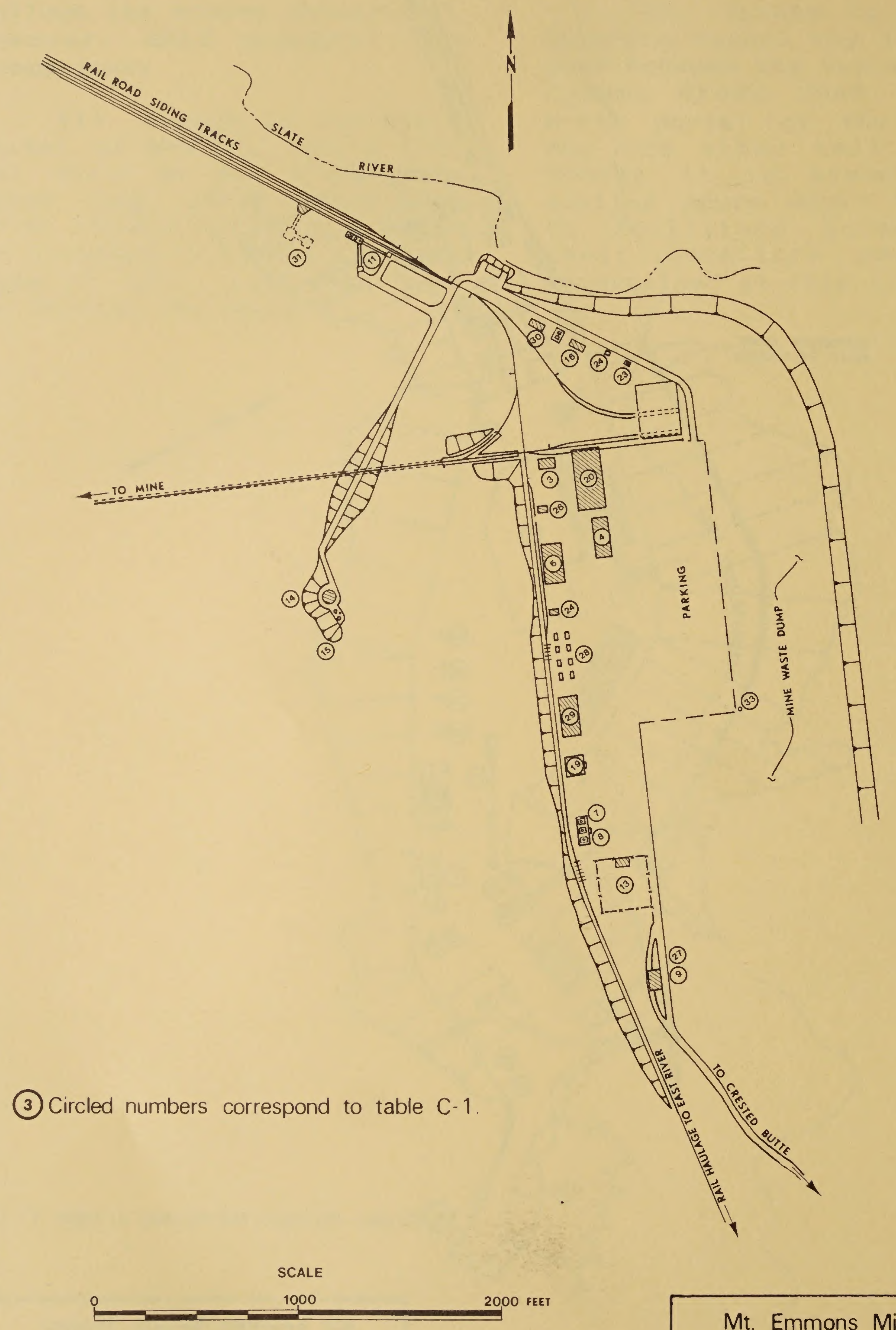
source: AMAX (1981 a)

Mt. Emmons Mining Project

COAL CREEK
MINE SITE PLAN

June 1981

FIG: C - 2


N
RAIL ROAD SIDING TRACKS
SLATE RIVER
TO MINE
PARKING
MINE WASTE DUMP
RAIL HAULAGE TO EAST RIVER
TO CRESTED BUTTE
31
11
30
16
24
23
20
3
26
4
6
24
28
29
19
7
8
13
27
9
14
15
33
SCALE
0
1000
2000 FEET

③ Circled numbers correspond to table C-1.

source: AMAX (1981a)

Mt. Emmons Mining Project

SLATE RIVER
MINE SITE PLAN

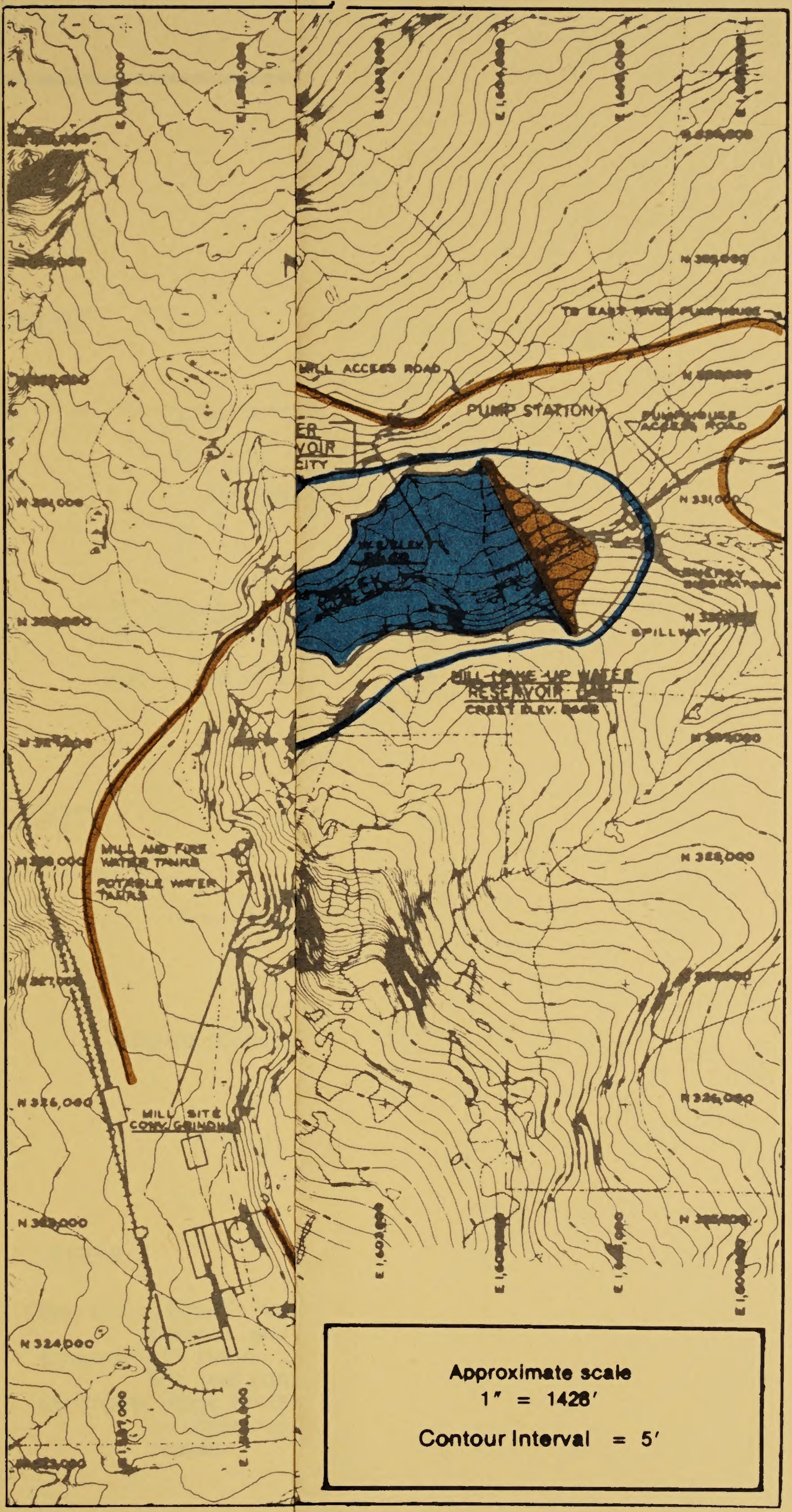
June 1981

FIG. C-3

Figure: C - 4
VIEW OF ALKALI
CREEK MILL/
TAILINGS SITE AREA.

Figure: C - 5
VIEW OF CARBON
CREEK MILL/
TAILINGS SITE AREA

Figure: C - 6
VIEW OF CHANCE
GULCH MILL/
TAILINGS SITE AREA.


TO EAST RIVER PUMPHOUSE
MILL ACCESS ROAD
PUMP STATION
PUMPHOUSE ACCESS ROAD
N 331,000
SPILLWAY
MILL MAKE-UP WATER RESERVOIR DAM
CREST ELEV.
MILL AND FIRE WATER TANKS
POTABLE WATER TANKS
MILL SITE
N 326,000
N 324,000
Approximate scale
1" = 1428'
Contour Interval = 5'

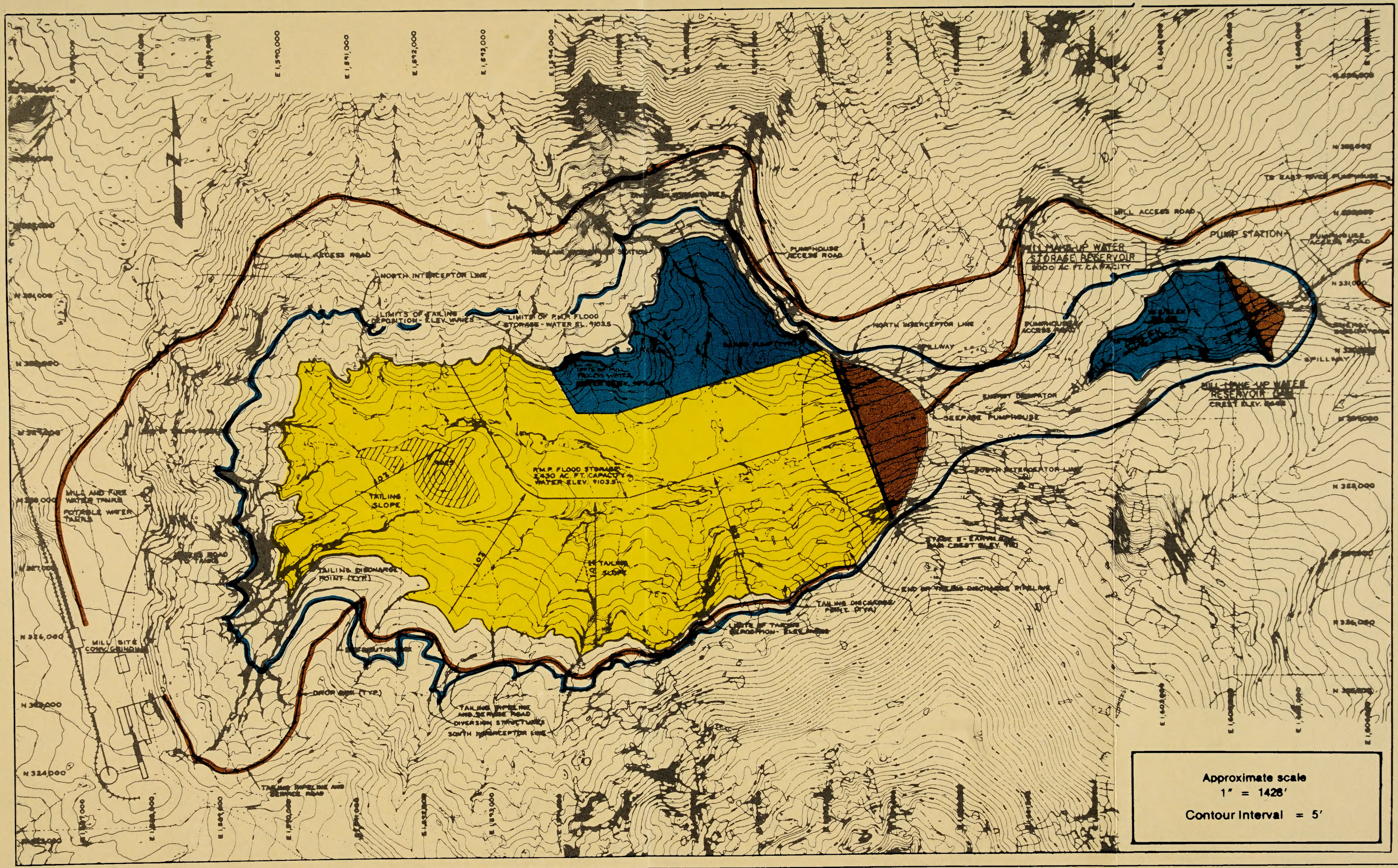
Legend

🟨	Tailing pond surface
🟫	Tailing pond and mill make-up water reservoir dams
🟦	Mill make-up water reservoir surface

Mt. Emmons Mining Project

ALKALI CREEK TAILING DISPOSAL AREA

July 1981 | FIG. C-7


E 1,590,000
E 1,591,000
E 1,592,000
E 1,593,000
N
MILL ACCESS ROAD
NORTH INTERCEPTOR LINE
LIMITS OF TAILING DEPOSITION - ELEV. VARIES
LIMITS OF P.M.P. FLOOD STORAGE - WATER EL. 9103.5
LIMITS OF MILL PROCESS WATER
PUMPHOUSE ACCESS ROAD
TO EAST RIVER PUMPHOUSE
MILL ACCESS ROAD
PUMP STATION
PUMPHOUSE ACCESS ROAD
MILL MAKE-UP WATER STORAGE RESERVOIR
5000 AC. FT. CAPACITY
NORTH INTERCEPTOR LINE
PUMPHOUSE ACCESS ROAD
SPILLWAY
SPILLWAY
ENERGY DISSIPATOR
SEEPAGE PUMPHOUSE
MILL MAKE-UP WATER RESERVOIR DAM
CREST ELEV. 8968
N 331,000
N 328,000
N 326,000
N 324,000
MILL AND FIRE WATER TANKS
POTABLE WATER TANKS
TAILING SLOPE
P.M.P. FLOOD STORAGE
2,430 AC. FT. CAPACITY
WATER ELEV. 9103.5
TAILING SLOPE
TAILING DISCHARGE POINT (TYP.)
MILL SITE
CONV./GRINDING
DROP BOX (TYP.)
TAILING PIPELINE AND SERVICE ROAD
DIVERSION STRUCTURES
SOUTH INTERCEPTOR LINE
TAILING PIPELINE AND SERVICE ROAD
SOUTH INTERCEPTOR LINE
STAGE II - EARTHFILL DAM CREST ELEV.
END OF TAILING DISCHARGE PIPELINE
TAILING DISCHARGE POINT (TYP.)
LIMITS OF TAILING DEPOSITION - ELEV. VARIES
E 1,602,000
Approximate scale
1″ = 1426′
Contour Interval = 5′

Legend

🟨 Tailing pond surface

🟫 Tailing pond and mill make-up water reservoir dams

🟦 Mill make-up water reservoir surface

🟦 Mill process water

— Interceptor canals

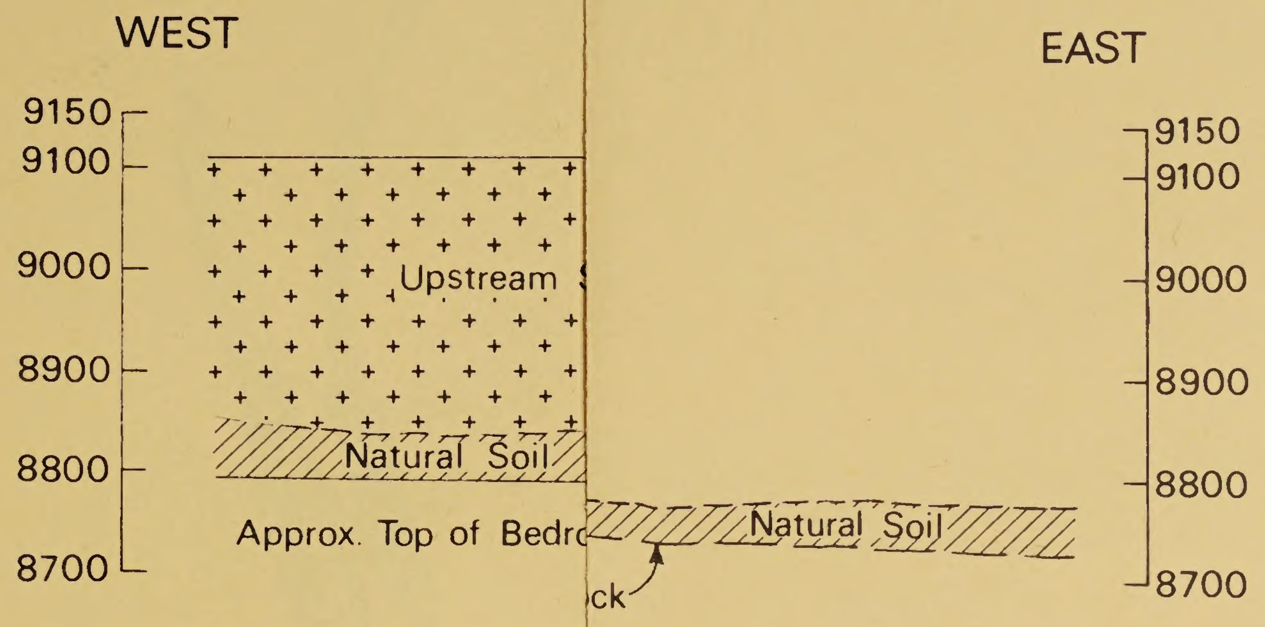
— Access Road

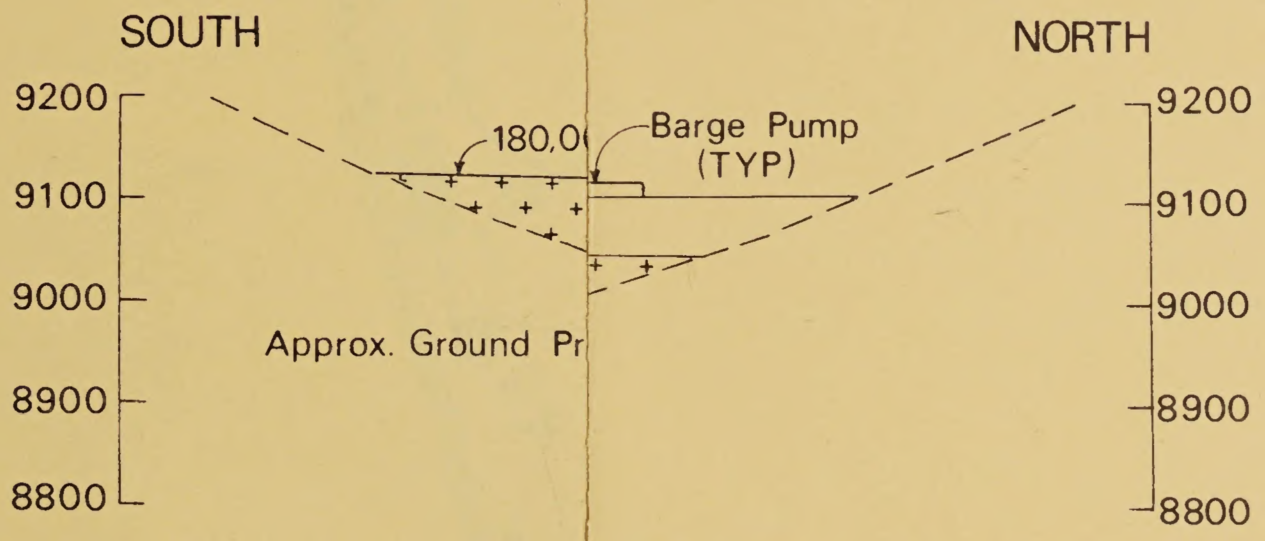
SOURCE: Stearns-Roger (1980)

Mt. Emmons Mining Project

ALKALI CREEK
TAILING DISPOSAL AREA

July 1981 | FIG. C-7


WEST
EAST
9150
9100
9000
8900
8800
8700
Upstream
Natural Soil
Approx. Top of Bedr
ck
Natural Soil
9150
9100
9000
8900
8800
8700


SOUTH
NORTH
9200
9100
9000
8900
8800
180,0
Barge Pump
(TYP)
Approx. Ground Pr
9200
9100
9000
8900
8800

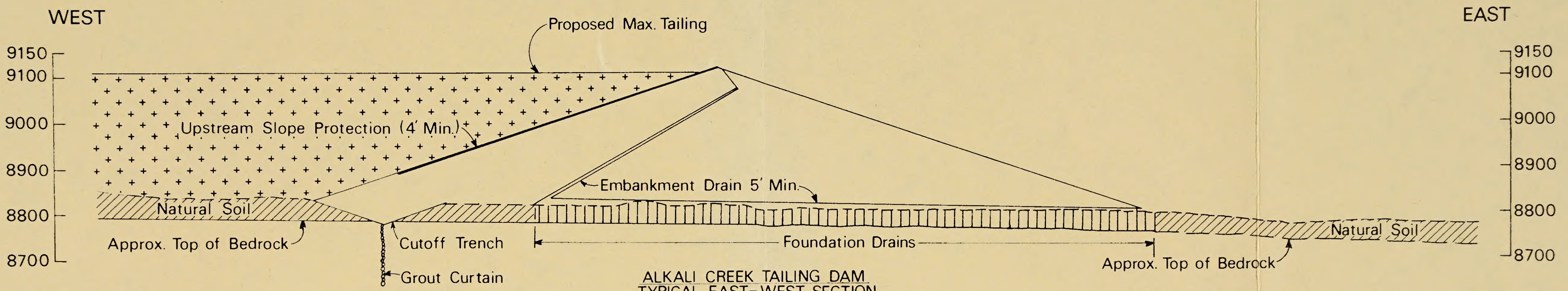
LEGEND

Foldation Drain - Hole dril
bedrock and bac
Embankment Drain - Clean
lifts and compact
Upstream Slope Protection
or other material
erosion.

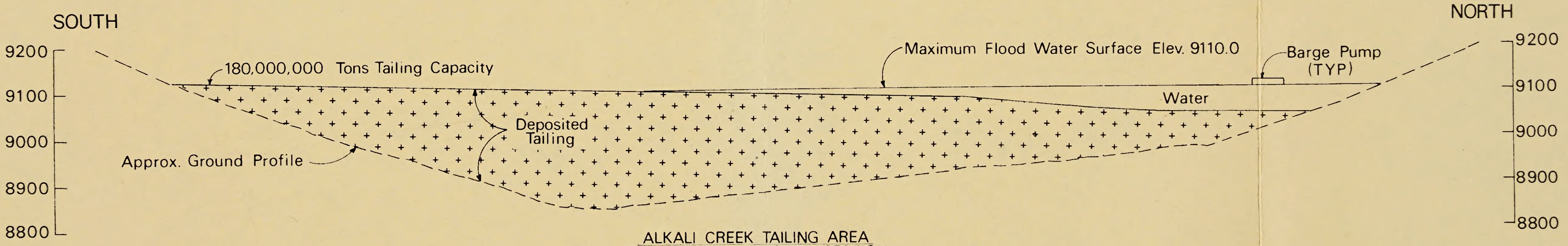
Mt. Emmons Mining Project

ALKALI CREEK
EARTHFILL DAM (Typical)

June 1981 | FIG. C-8


WEST
EAST
9150
9100
9000
8900
8800
8700
Proposed Max. Tailing
Upstream Slope Protection (4' Min.)
Embankment Drain 5' Min.
Natural Soil
Approx. Top of Bedrock
Cutoff Trench
Grout Curtain
Foundation Drains
Approx. Top of Bedrock
Natural Soil

ALKALI CREEK TAILING DAM
TYPICAL EAST–WEST SECTION
Scale = 1"=250'


SOUTH
NORTH
9200
9100
9000
8900
8800
180,000,000 Tons Tailing Capacity
Maximum Flood Water Surface Elev. 9110.0
Barge Pump (TYP)
Water
Deposited Tailing
Approx. Ground Profile

ALKALI CREEK TAILING AREA
TYPICAL NORTH–SOUTH SECTION
Scale = Hor. 1"= 500'
Vert. 1"= 250'

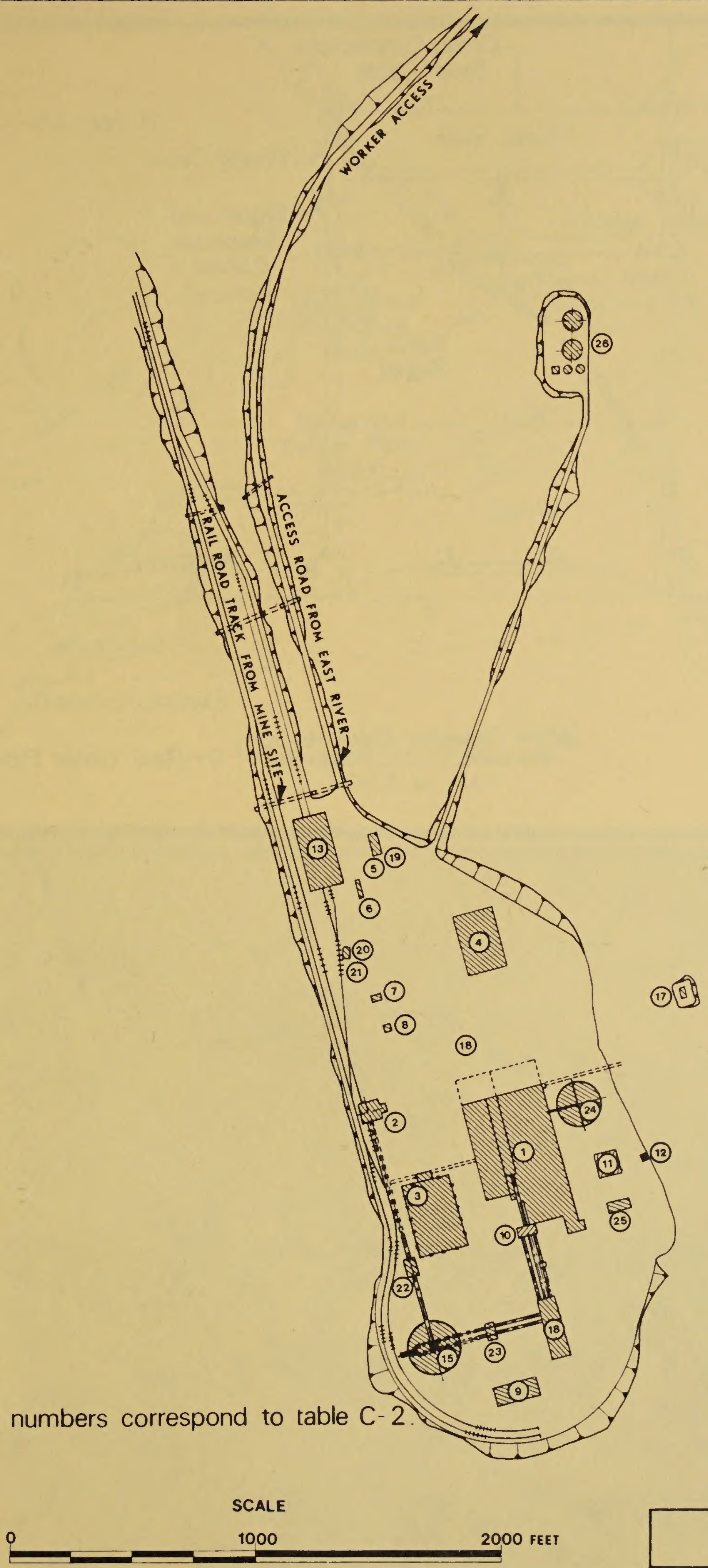
LEGEND

Foundation Drain – Hole drilled through natural soils to bedrock and backfilled with drain material.
Embankment Drain – Clean sands and gravels placed in lifts and compacted to moderate density.
Upstream Slope Protection – Hard, durable rock riprap or other material suitable to minimize wave erosion.

Mt. Emmons Mining Project

ALKALI CREEK
EARTHFILL DAM (Typical)

June 1981 | FIG. C-8


WORKER ACCESS
ACCESS ROAD FROM EAST RIVER
RAIL ROAD TRACK FROM MINE SITE
N
1
2
3
4
5
6
7
8
9
10
11
12
13
15
16
17
18
19
20
21
22
23
24
25
26
SCALE
0
1000
2000 FEET

⑤ Circed numbers correspond to table C-2.

Mt. Emmons Mining Project

ALKALI CREEK
MILL SITE PLAN

June 1981

FIG. C-9

source: Stearns-Roger (1978 a)

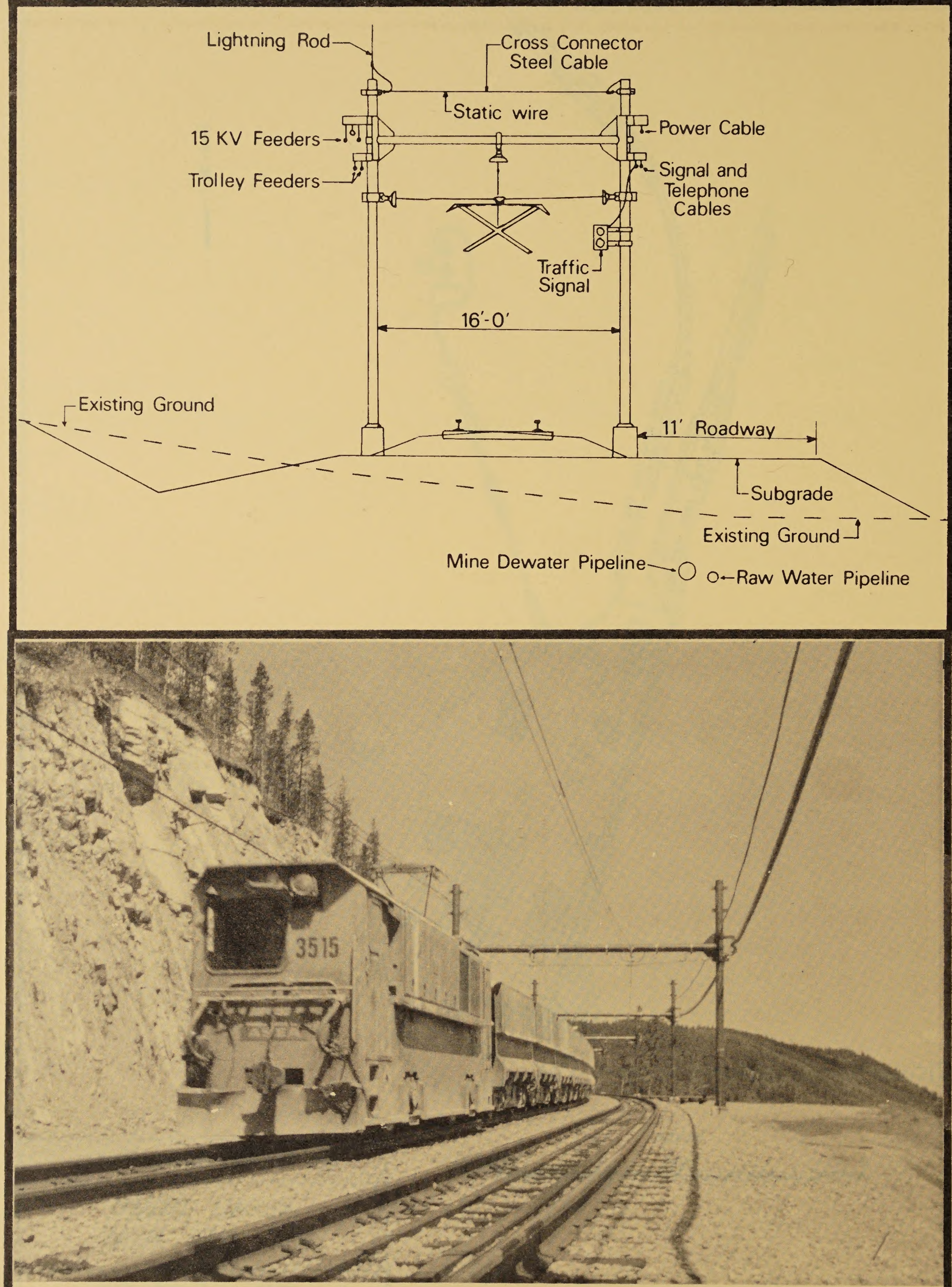
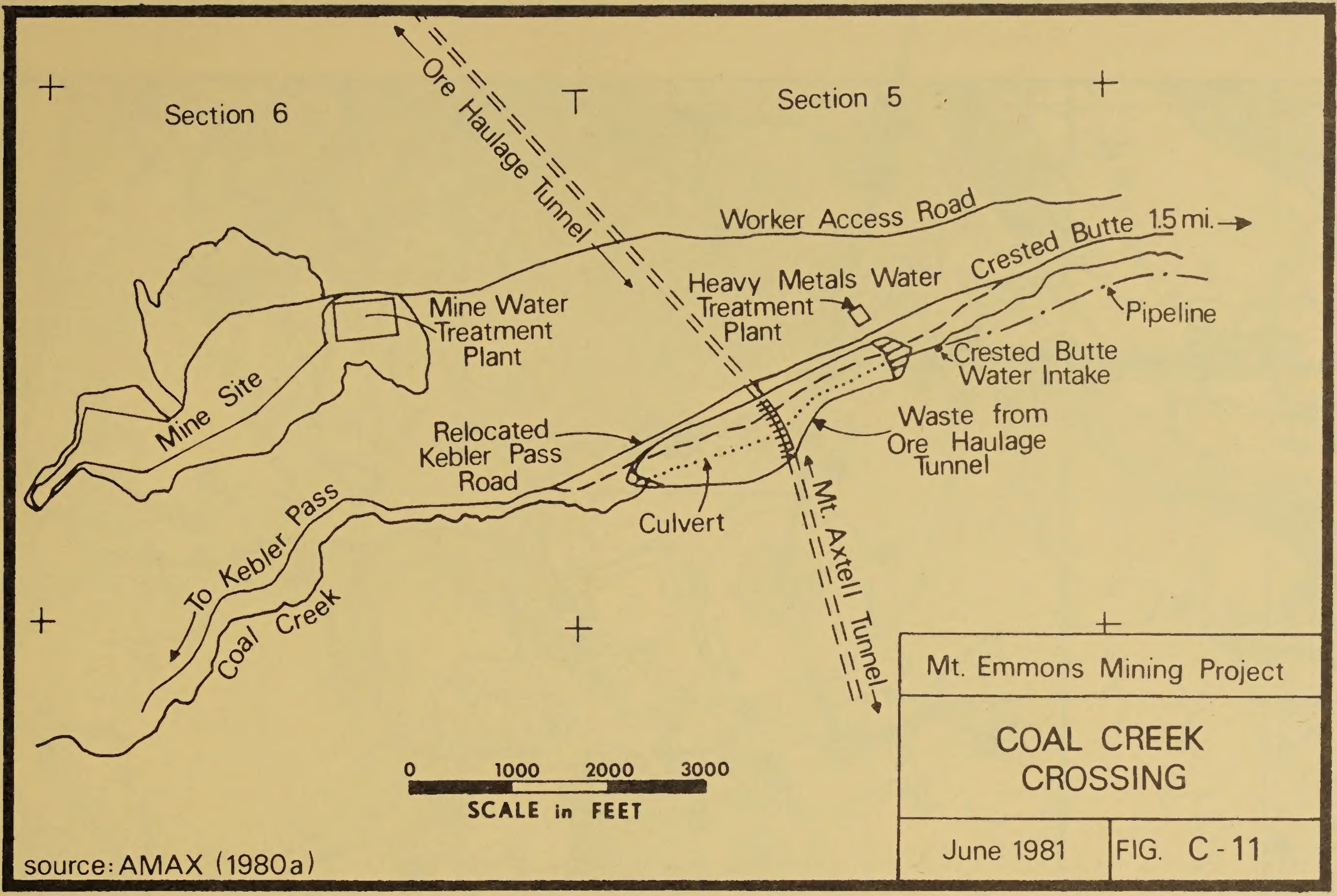

Lightning Rod
Cross Connector Steel Cable
Static wire
15 KV Feeders
Power Cable
Trolley Feeders
Signal and Telephone Cables
Traffic Signal
16'-0'
Existing Ground
11' Roadway
Subgrade
Existing Ground
Mine Dewater Pipeline
Raw Water Pipeline
3515

Figure: C-10 Typical Electric Rail System


Section 6
Section 5
Ore Haulage Tunnel
Worker Access Road
Crested Butte 1.5 mi.
Heavy Metals Water Treatment Plant
Mine Water Treatment Plant
Pipeline
Crested Butte Water Intake
Mine Site
Relocated Kebler Pass Road
Waste from Ore Haulage Tunnel
Culvert
Mt. Axtell Tunnel
To Kebler Pass
Coal Creek
0
1000
2000
3000
SCALE in FEET

source: AMAX (1980a)

Mt. Emmons Mining Project

COAL CREEK CROSSING

June 1981

FIG. C-11

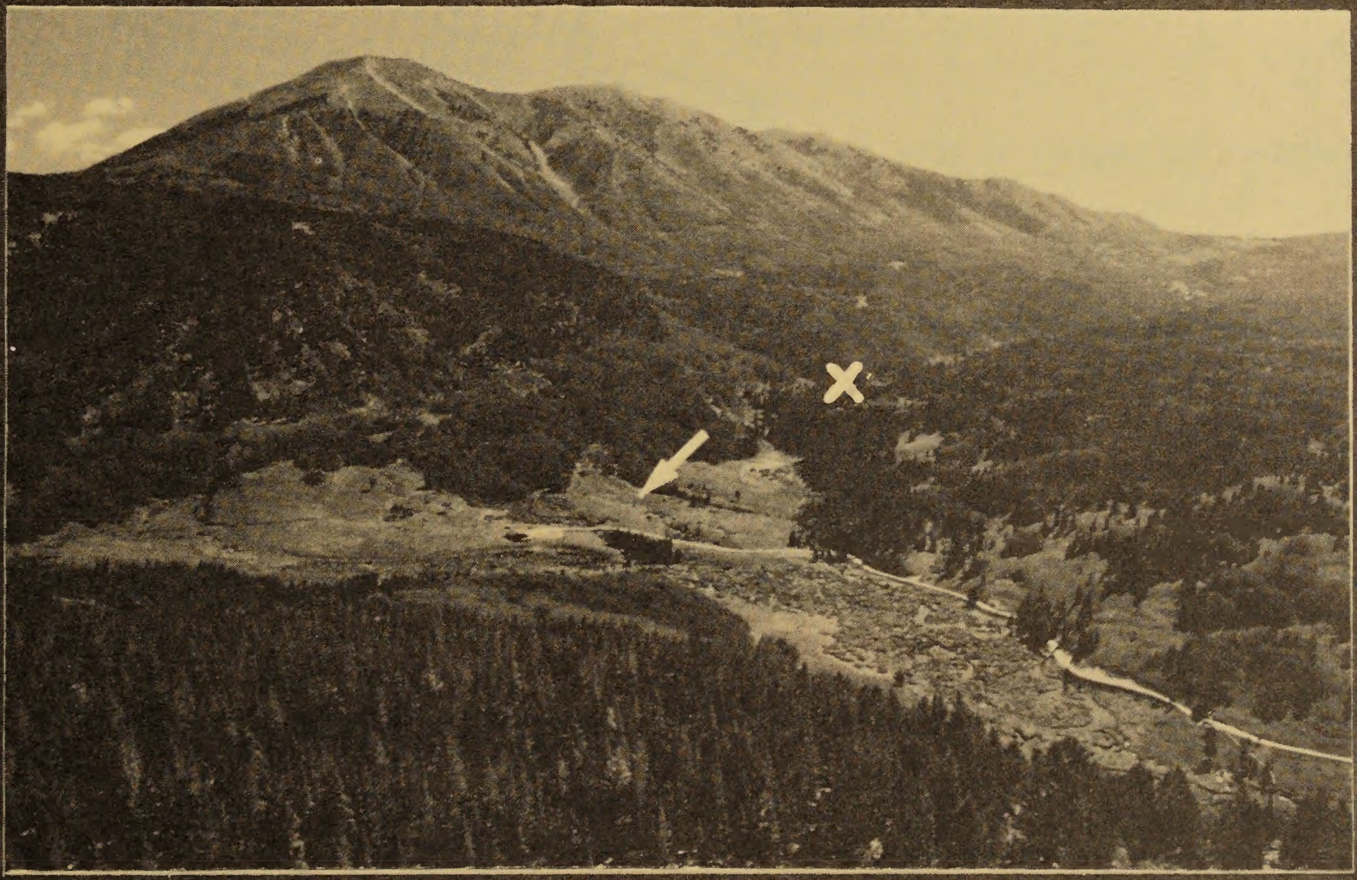
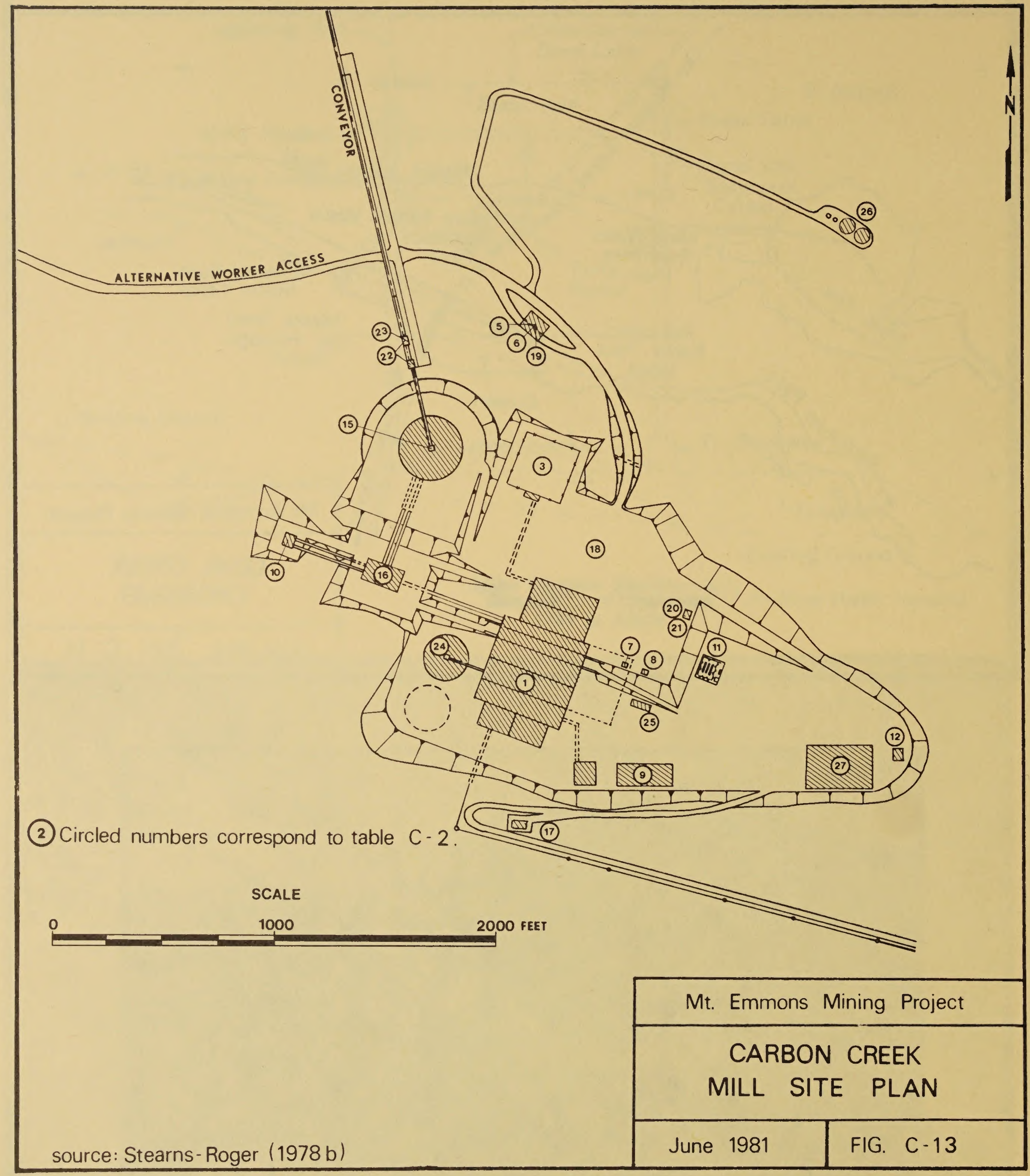


Figure: C-12

SOUTH PORTAL OF THE MT. AXTELL TUNNEL (Arrow) AND CARBON CREEK POTABLE WATER RESERVOIR (X).


N
CONVEYOR
ALTERNATIVE WORKER ACCESS
26
23
22
5
6
19
15
3
18
10
16
20
21
7
8
11
24
1
25
12
27
9
17
SCALE
0
1000
2000 FEET

② Circled numbers correspond to table C-2.

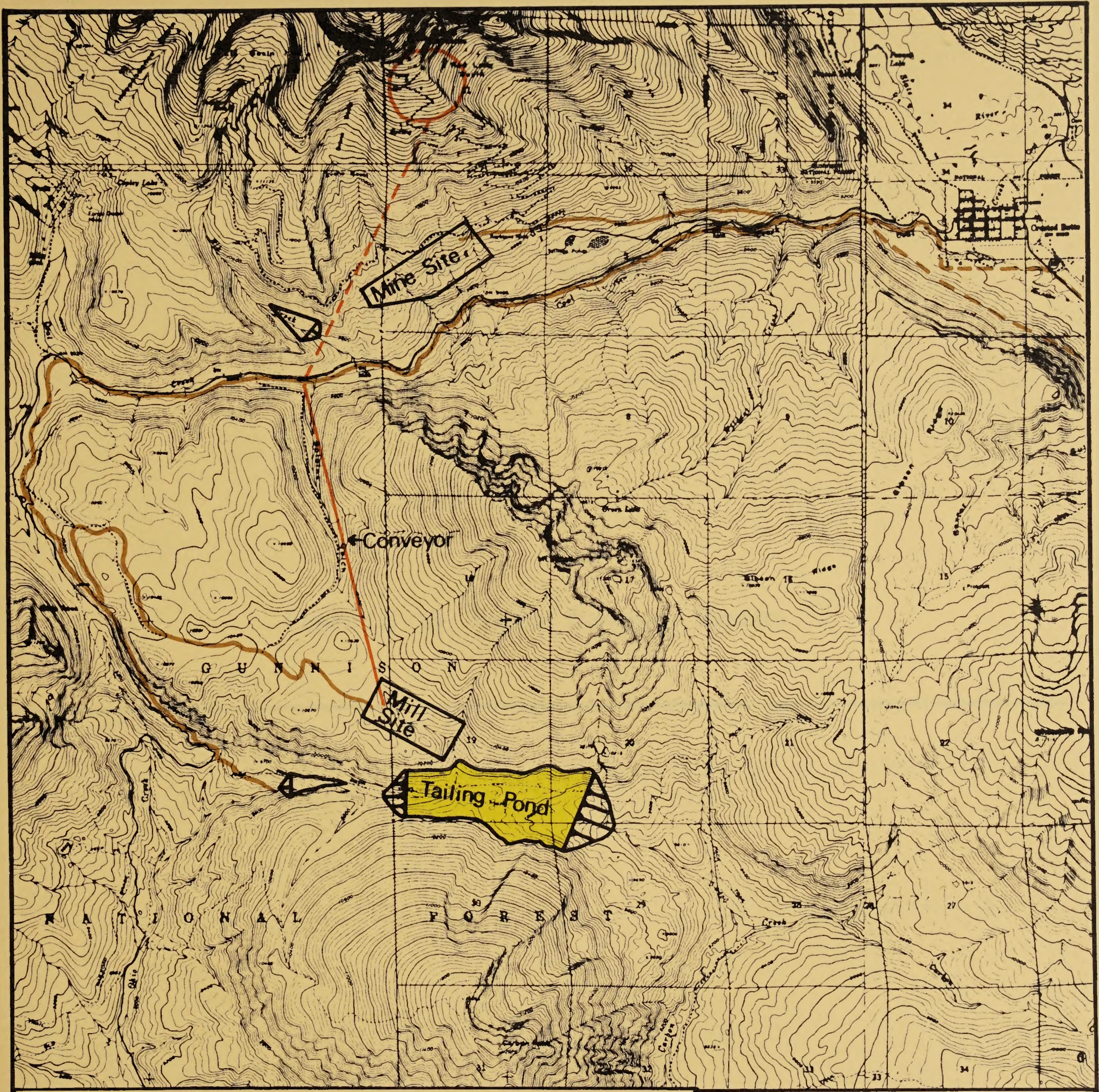
Mt. Emmons Mining Project

CARBON CREEK
MILL SITE PLAN

June 1981

FIG. C-13

source: Stearns-Roger (1978 b)


Mine Site
Conveyor
G U N N I S O N
Mill Site
Tailing Pond
N A T I O N A L
F O R E S T

LEGEND

- - - - - UNDERGROUND HAULAGE

——— SURFACE HAULAGE

——— WORKER ACCESS

Mt. Emmons Mining Project

10,000 TON PER DAY
ALTERNATIVE

July 1981

FIG. C-14

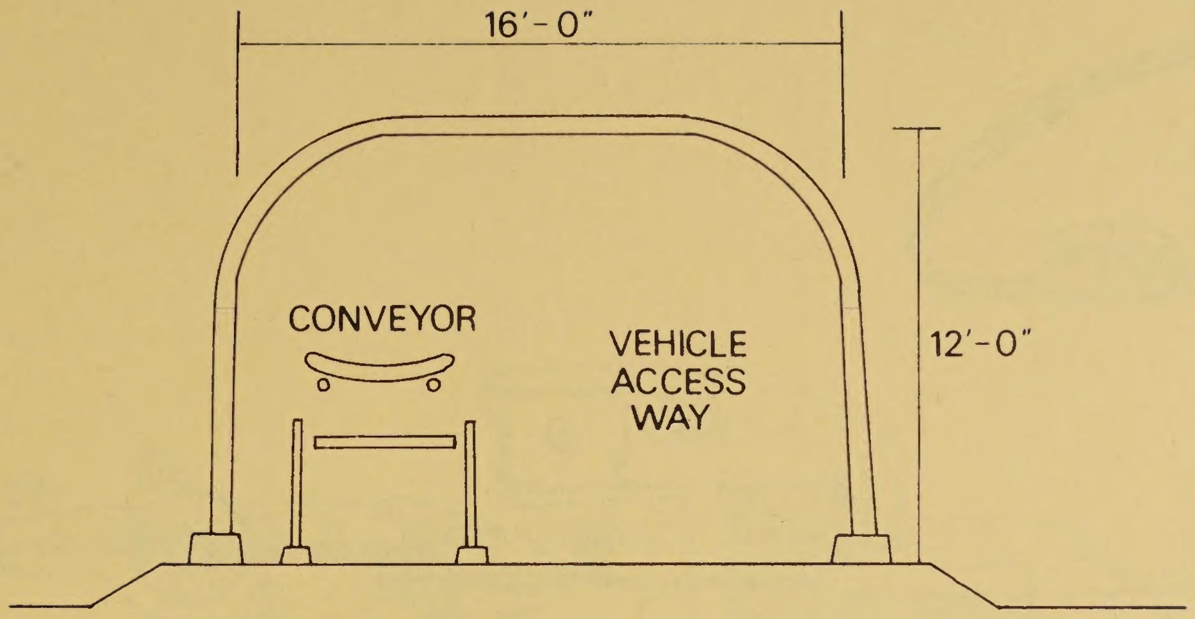
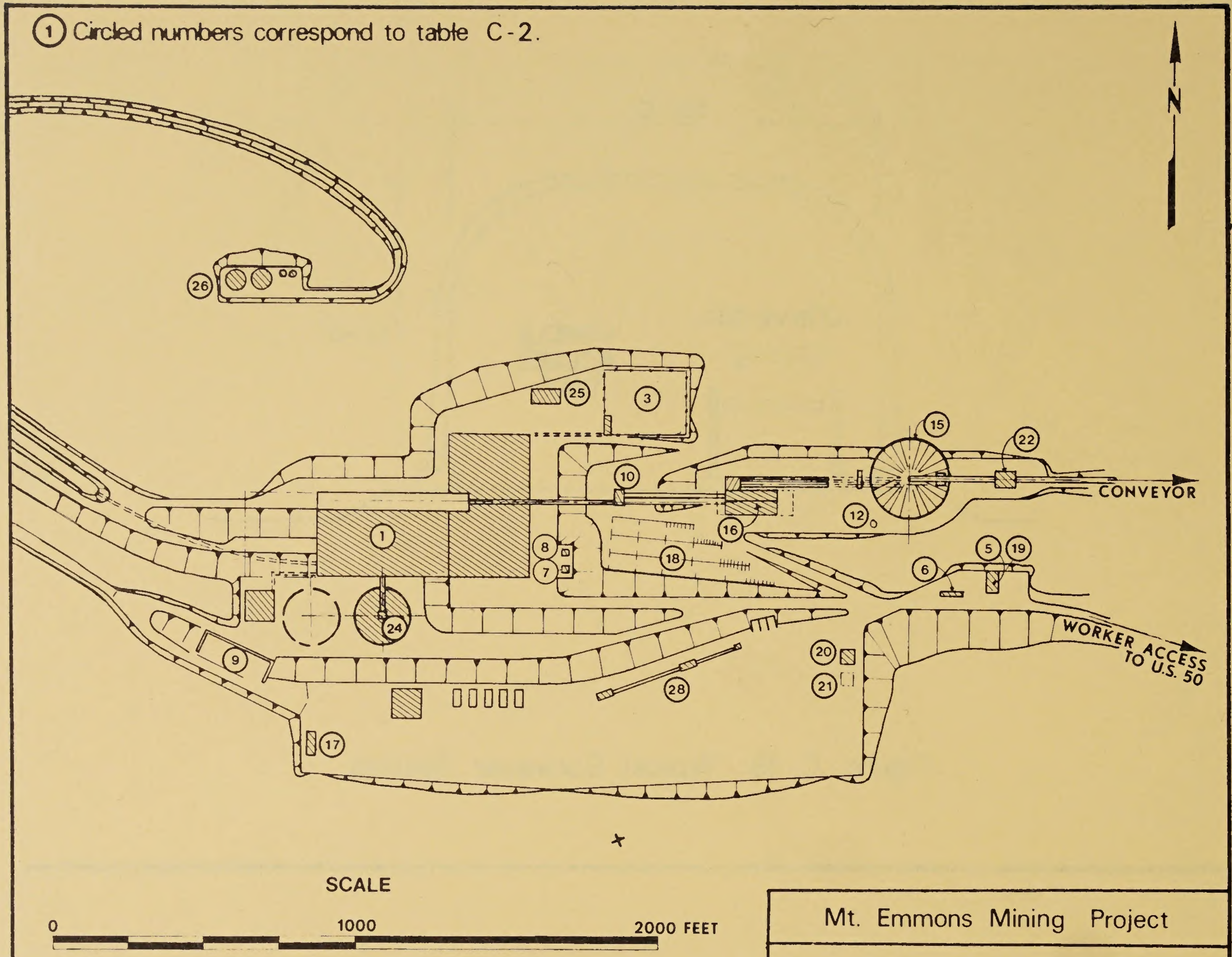

16'-0"
12'-0"
CONVEYOR
VEHICLE
ACCESS
WAY

Figure: C-15 Typical Conveyor System

① Circled numbers correspond to table C-2.


N
26
25
3
15
22
10
CONVEYOR
12
16
1
8
7
18
5
19
6
24
9
20
21
28
17
WORKER ACCESS TO U.S. 50
SCALE
0
1000
2000 FEET

Mt. Emmons Mining Project

CHANCE GULCH
MILL SITE PLAN

June 1981

FIG. C-16

source: Stearns-Roger (1979 a)

Appendix D. Power Supply Details

APPENDIX D: POWER SUPPLY DETAILS

This appendix contains technical power supply details underlying the full range of alternatives that were considered. These details include the following items necessary for delivering electrical power to the project: electrical source, delivery method, voltage, and corridor location. Some of these alternatives were eliminated from further detailed study, as described in Chapter 2.

Electrical Source

The existing local electrical grid does not have the capacity to provide for the project's needs. AMAX wants the project to be connected to two independent electrical sources to insure a safe and efficient operation.

At the mine, electrically powered features include the ventilation system, the mine drainage pumping system, the air compressors, and the fire protection system. All these are essential for the maintenance of safe underground working conditions.

At the mill, virtually all of the equipment runs on electricity and even brief variations in the electrical supply cound cause an automatic shutdown to protect the motors. Restart time can take several hours, during which the production of concentrate is suspended.

For the above reasons, AMAX proposes two independent power sources, so that electrical failures and fluctuations do not endanger worker safety or reduce plant efficiency. Studies were made to determine alternatives that would satisfy this requirement (CDM, 1980e-n, AMAX, 1981a).

The construction of transmission lines from two independent sources required the identification of available sources. The first phase of the transmission line studies identified existing and planned potential electrical sources in all directions from the project (CDM, 1980e). These potential sources are shown in Figure D-1 and described in Table D-1.

The next two phases of the transmission line studies considered environmental constraints imposed by wilderness areas, Forest Service recommended RARE II areas, wildlife, geologic hazards, alpine and subalpine environments, and visual resources. Additional engineering considerations of availability of electricity and source distances were also considered.

The result of these studies was the identification of a corridor analysis area that joined to three suitable independent transmission lines (Figure D-2): (1) a 230 kV line owned by Western Area Power Administration (Western) and located south of Gunnison, which later studies have shown to be useable only as an emergency supply (See page 4-148); (2) a 69 kV line near Redstone owned by Public Service of Colorado; and (3) a proposed double circuit 345 kV transmission line being planned by Colorado Ute Electric Association which will connect Rifle, Colorado, to the San Juan Generating Plant in New Mexico and is currently planned to pass through the vicinity of Paonia.

Another source could involve generating emergency electricity onsite, in which case only one transmission line with adequate capacity would have to be provided to serve as the primary electrical supply tapping an existing line or source.

Electrical Transmission Lines

AMAX's Plan of Operations (AMAX, 1980a, 1981a) proposes the installation of overhead transmission lines from two independent sources. This proposal (not included in Alternative 2 because the only application that has been submitted to the Forest Service is from GCEA) taps Western's 230 kV line southeast of Gunnison, proceeds northward through Chance Gulch, the Alkali Creek millsite and Carbon Creek, to connect with the Coal Creek mine site. From the mine, the transmission line extends westward over Kebler Pass to a tap on Colorado Ute's proposed 345 kV line near Paonia.

GCEA, working through agreements with AMAX, applied to the Forest Service and the BLM to construct and operate three transmission lines located partly on federally-owned lands (Alternative 2). The purpose of these lines is primarily to serve the Mt. Emmons Project, but they also will increase the reliability, flexibility, and capability of the existing system.

Three tranmission lines will be designed, constructed, and operated at 115 kV and 230 kV:

One line will begin at a new 345/115 kV North Fork Substation on the Colorado Ute line, which is currently in advanced planning stages. This substation will be located south of Paonia in Delta County. The line will extend east over Kebler Pass and terminate at the Mt. Emmons Mine Substation near Crested Butte in Gunnison County.

The second 115 kV line will go east about 5 miles from the Mine Substation to the Crested Butte Substation.

The third 115 kV line will go south from the Mine Substation and connect with two additional new substations. One will be located at the south portal of the Mt. Axtell tunnel, and the other at the Alkali Creek mill. The line will then continue south to the Skito Substation located approximately 1 mile west of Gunnison. There would be a double circuit 230 kV tap line between the Skito Substation and Western's 230 kV transmission line located approximately 7 miles south of the Skito Substation.

Although CDM's transmission line studies and AMAX's Environmental Report (AMAX, 1981a) identified a preferred corridor east of Gunnison (included in Alternative 7), GCEA has proposed a corridor west of Gunnison (Alternative 2). GCEA submits that it has adequate electrical transmission systems on the east side of Gunnison and that its long range plans are to develop the existing Skito substation west of Gunnison as the power center for the upper Gunnison Basin.

The proposed system will connect to seven substations. The Paonia tap and substation on Colorado Ute's proposed 345 kV line would serve several loads including the Mt. Emmons Project. The tap and substation on Western's 230 kV line south of Gunnison will serve several systems, too. Both of these new substations will include space for parking, outdoor storage and buffer zone areas totalling approximately 40 acres each. Two existing substations, at Gunnison (Skito) and Crested Butte (Crested Butte Substation), will require changes in existing equipment to handle the new system. Three additional substations (at the mine site, at the south portal of the Mt. Axtell tunnel, and at the mill) will be constructed to serve Project loads. Each of these will require approximately two acres of land.

Since final alignments of the lines have not been established, the corridors analyzed are approximately 1 mile wide. Final construction plans will influence areas averaging less than 200 feet wide.

Structures associated with the transmission system are listed in Table D-2. Typical material requirements for high voltage transmission systems are listed in Table D-3. Some technical specifications for the proposed system are:

(1) 115 kV capacity on the majority of the line;

(2) 230 kV capacity on the line segment between the South Tap and the Skito Substation;

(3) 55.046 mW maximum load at a 15 minute peak load;

(4) approximately 76 total miles;

(5) Typical span lengths of 500-1300 feet, depending on topography and engineering design considerations;

(6) Normal system transmission capacity of 80 megawatts;

(7) Conductor size 556 MCM ASCR; and

(8) Approximate total capital cost $20,783,000 (1981 dollars).

Alternative Configurations

One Electrical Transmission Line with Onsite Generating Capacity - Under this alternative only one overhead transmission line would be constructed. It could be connected with either the Hopkins substation near Carbondale or the 345 kV line near Paonia as shown in Figure D-1. The corridor options for this line are the corridors described on Figure D-2. The onsite generators would be used on a standby basis and would only be large enough to operate emergency equipment and life support facilities. Structures associated with this alternative are listed in Table D-2. See page 222 for a discussion of costs related to onsite power generation.

An onsite coal-fired power plant requiring 80-100 acres would be located, most logically, either at the mine site in the Coal Creek valley or at the mill site. The site facilities would include a building housing the coal handling equipment, boilers, turbine generators, condensors, emission control devices, control room and maintenance shops, a substation/ transformer yard, a water reservoir, cooling towers, coal stockpile, limestone silos, and an ash disposal area. When operating at its full capacity, the plant would consume 540 tons of coal and 3 acre-feet of water per day.

An onsite diesel-fired power plant would require about 20 acres, and would be located either in the Coal Creek valley near the mine site or near the mill site. The plant would include a building housing eight 8,900 HP diesel generator units and a control center, a 1.5 million gallon fuel and lube oil storage reservoir, a substation/transformer yard, and a propane or compressed air system for engine starting. When operating at its normal capacity, the plant would consume nearly 78,000 gallons of fuel oil, 550 gallons of lube oil, and 2 acre-feet of water per day. See Chapter 2, page 40 for an explanation of why these alternatives were not considered in further detail.

Combination Overhead and Buried (Alternative 6) - The proposal from GCEA only discusses overhead transmission lines. An alternative to this is to bury certain segments that pass through a visually critical area identified by the Forest Service between Marcellina Mountain and Kebler Pass.

The underground portion of this combination would typically be a High Pressure Oil-Filled (HPOF) pipe-type system. Oil is pumped through this system to cool the conductors. Table D-3 describes approximate material requirements per circuit mile for a 115 kV HPOF system. Additional structures associated with underground transmission lines are listed in Table D-2.

Other Corridors - Figure D-2 includes corridors other than the ones preferred by CDM's studies (Alternative 7) and GCEA (Alternative 2). Phase 4 of the transmission line studies evaluated all of the surrounding terrain and identified these potential corridors based on environmental and engineering desirability (CDM, 1980e-n). These corridors were considered when sructuring Power Supply Configurations in Alternatives 3, 4, 5, and 6. Since final alignments have not been established, the corridors shown are approximately one mile in width. At the time of final design, slight deviations beyond the corridor boundaries may be necessary to accommodate design requirements.

The Federal Land Policy Management Act (FLPMA) requires that the Forest Service approve final construction plans prior to actual work. These plans will incorporate required mitigation measures in determining exact alignments and other details. Larger-scaled maps of the corridors can be found in CDM (1980e-n).

All of the configurations create a loop system connecting the 230 kV line south of Gunnison owned by the Western Area Power Administration with a proposed 345 kV line which will be owned by Colorado Ute Electric Association.

Voltage - Alternatives 1, 2, 3, 4, and 7 are primarily 115 kV systems. For reasons discussed in Chapter 4, Alternatives 5 and 6 consider a system that is 230 kV. This system would have a normal system transmission capacity of about 250 megawatts. The towers for a 230 kV system are typically 15 to 30 feet taller than for a 115 kV system and the spans can be longer, depending on specific tower design.

TABLE D-1. EXISTING AND PLANNED TRANSMISSION LINES

Ownership	General Location	Voltage	Utilization (%)*		Approximate Distance From Project**	Difficulty of Terrain
			Present	Projected		
Western Area Power Administration (Existing)	South of Gunnison	230 kV	95	100	20.0 mi.(mill)	Low
Western Area Power Administration (Existing)	East of Paonia	230 kV	80	95	30.0 mi.(mine)	Medium
Public Service Co. of Colorado (Existing)	Redstone	69 kV	75	Unknown	35.0 mi.(mine) Carbondale	Medium-High
Colorado-Ute-Western (Planned)	Near Paonia	345 kV	***	50	30.0 mi.(mine)	Medium
Colorado-Ute and Public Service Co. of Colorado (Planned)	Buena Vista	345 kV	***	Unknown	50 + mi. (Estimated)	High

- - - - -

*These estimates are for normal or average conditions; and with normal losses, voltage drop, and power factor. All major lines in this overall transmission network will at times become fully loaded, or temporarily overloaded with sacrifice of high power loss and voltage drops. This is dependent on scheduled or unscheduled outages of major equipment and lines at various locations for maintenance or other reasons.

**Within the project area there will be three substations: at the mine on the north, at the mill on the south, and at the portal between the two. Mileages: mine to portal 6 mi.; portal to mill 7 mi.

***Not in operation at time of writing.

TABLE D-2 POWER SUPPLY SYSTEM STRUCTURES

Overhead Transmission

- three substations
- access roads
- three conductors
- poles or towers (the number and type depend on final design)
- two overhead ground wires

Underground Transmission

- six cable terminations
- three cables
- access roads
- manholes (the number required depends on the type of system and its length)

Onsite Generation

- transformers
- local delivery lines
- generator and building
- fuel storage

TABLE D-3. TYPICAL MATERIAL REQUIREMENTS FOR HIGH VOLTAGE TRANSMISSION SYSTEMS

115 kV Underground High Pressure Oil-Filled*

Materials	Quantities per Circuit Mile
2,000 kcmil Copper Conductor	98,000 lbs
Insulation (oil-impregnated paper tape)	26,000 lbs
Steel pipe	118,000 lbs
Insulating Oil	9,500 gal

115 kV Overhead with Wooden 'H' Frame Structures**

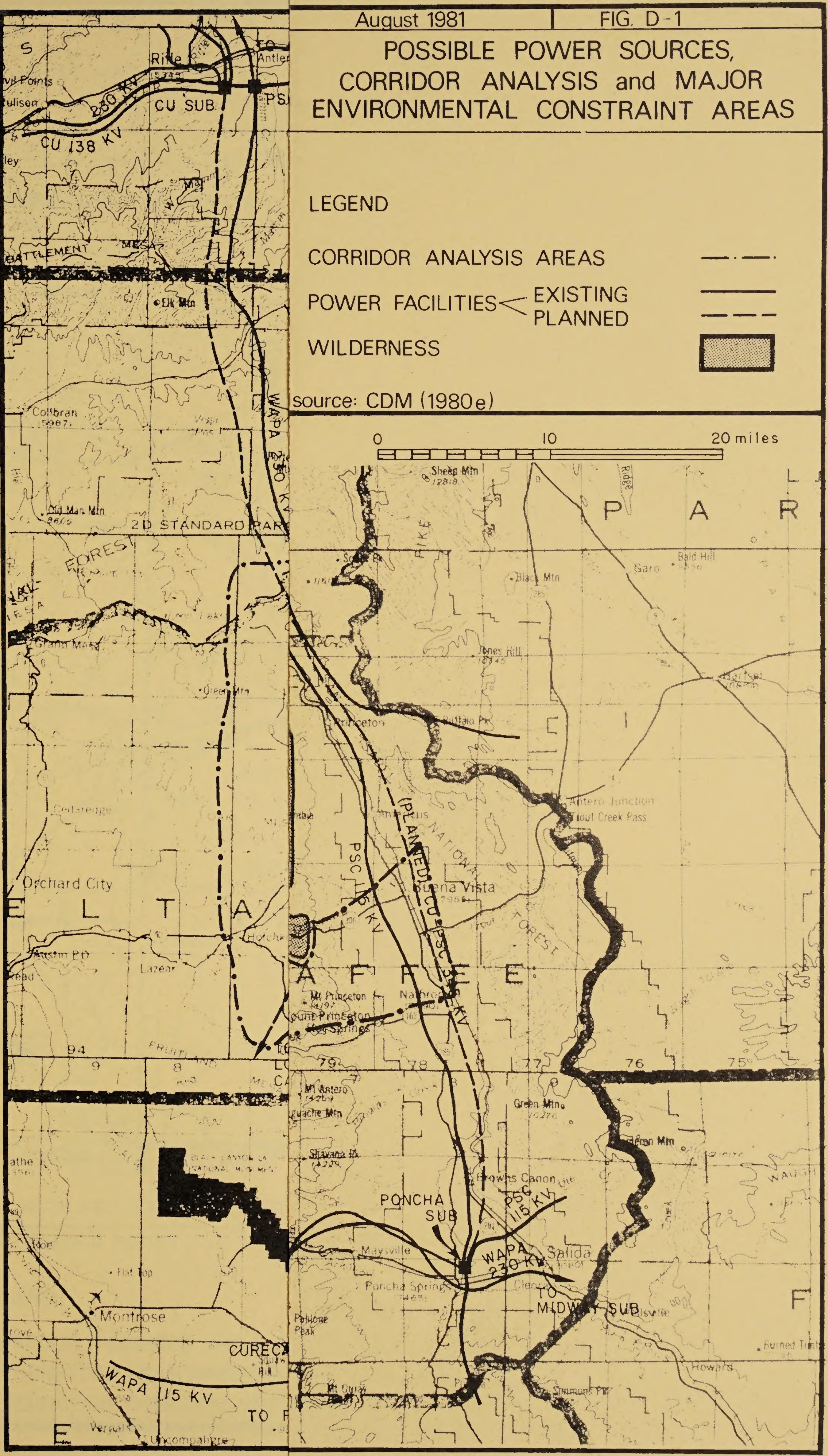
Materials	Quantities per Circuit Mile
Wood Poles	16-18
Wood Crossarms	8-9
Type 556 MCM Conductor	12,957 lbs
3/8-inch Overhead Groundwire	2,882 lbs
Insulator Bells	297

230 kV Overhead with Steel Lattice Structures**

Materials	Quantities per Circuit Mile
Steel Towers	98,000 lbs
Type 1272 MCM Conductor	22,143 lbs
1/2-inch Overhead Groundwire	5,458 lbs
Insulator Bells	420
Concrete	12.7 cu. yd.

* Source: EPRI, 1975.

** Based on Forest Service Calculations



August 1981

FIG. D-1

POSSIBLE POWER SOURCES, CORRIDOR ANALYSIS and MAJOR ENVIRONMENTAL CONSTRAINT AREAS

LEGEND
CORRIDOR ANALYSIS AREAS
POWER FACILITIES
EXISTING
PLANNED
WILDERNESS
0
10
20 miles
Rifle
CU SUB
PSA
230 KV
CU 138 KV
BATTLEMENT MESA
Elk Mtn
Collbran
WAPA 230 KV
Old Man Mtn
2D STANDARD PAR
FOREST
Grand Mesa
Green Mtn
Cedaredge
Orchard City
E L T A
Austin PO
Lazear
94
FRUITLAND
Montrose
CURECA
WAPA 115 KV
TO F
Uncompahgre
E
Sheep Mtn
P A R
Bald Hill
Black Mtn
Jones Hill
Buffalo Pk
Princeton
Antero Junction
Trout Creek Pass
PSC 115 KV
(PLANNED) CU-PSC 230 KV
NATIONAL FOREST
Buena Vista
A F F E E
Mt Princeton
Nathrop
Mount Princeton Hot Springs
79
78
77
76
75
Mt Antero
Green Mtn
Shavano Pk
Browns Canon
PONCHA SUB
PSC 115 KV
Maysville
WAPA 230 KV
Salida
Poncha Springs
TO MIDWAY SUB
Howard
Simmons Pk
Mt Ouray
Methyl Peak
Turret
F

source: CDM (1980e)

TABLE D-3. TYPICAL MATERIAL REQUIREMENTS FOR HIGH VOLTAGE TRANSMISSION SYSTEMS

115 kV Underground High Pressure Oil-Filled*

Materials	Quantities per Circuit Mile
2,000 kcmil Copper Conductor	98,000 lbs
Insulation (oil-impregnated paper tape)	26,000 lbs
Steel pipe	118,000 lbs
Insulating Oil	9,500 gal

115 kV Overhead with Wooden 'H' Frame Structures**

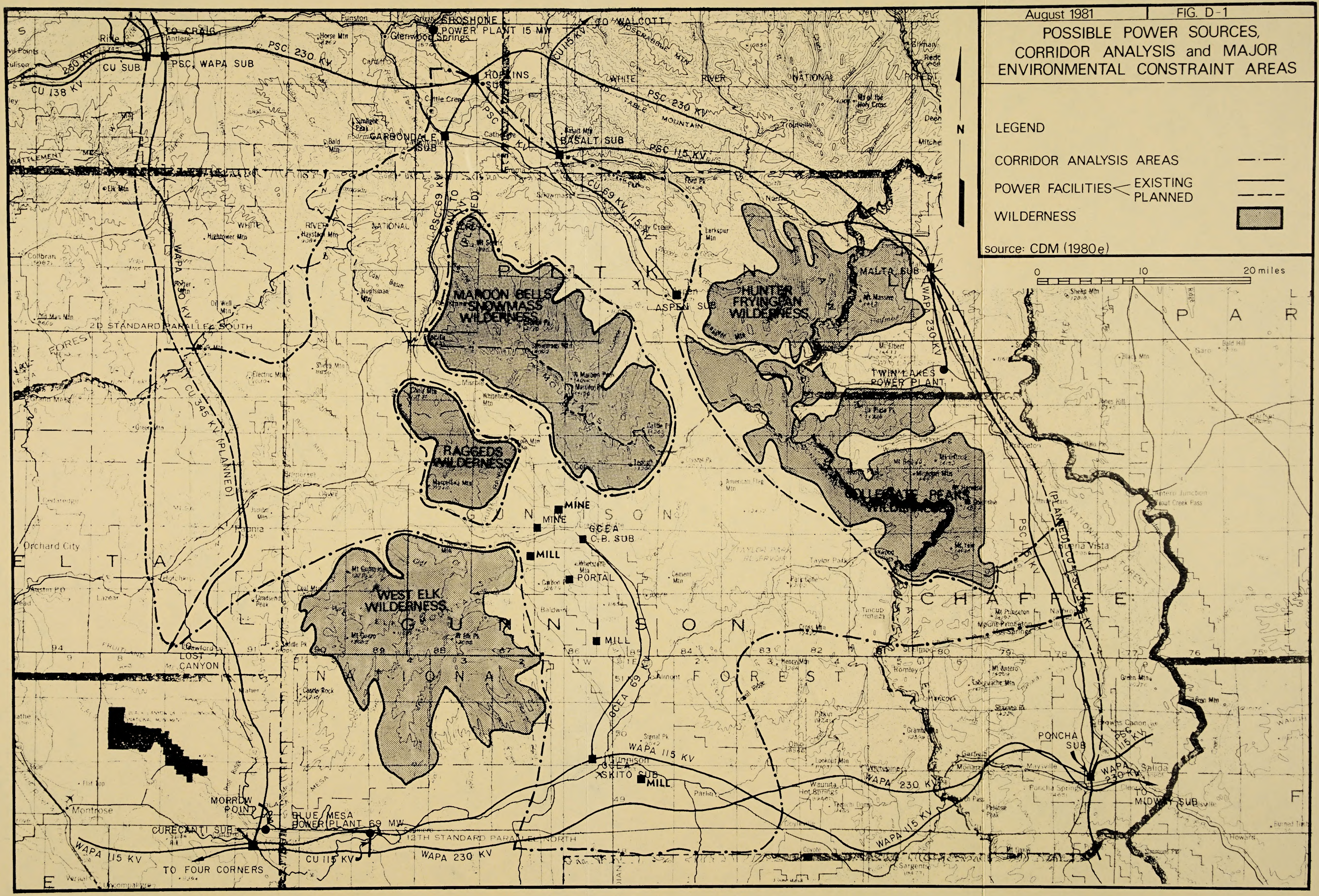
Materials	Quantities per Circuit Mile
Wood Poles	16-18
Wood Crossarms	8-9
Type 556 MCM Conductor	12,957 lbs
3/8-inch Overhead Groundwire	2,882 lbs
Insulator Bells	297

230 kV Overhead with Steel Lattice Structures**

Materials	Quantities per Circuit Mile
Steel Towers	98,000 lbs
Type 1272 MCM Conductor	22,143 lbs
1/2-inch Overhead Groundwire	5,458 lbs
Insulator Bells	420
Concrete	12.7 cu. yd.

* Source: EPRI, 1975.

** Based on Forest Service Calculations



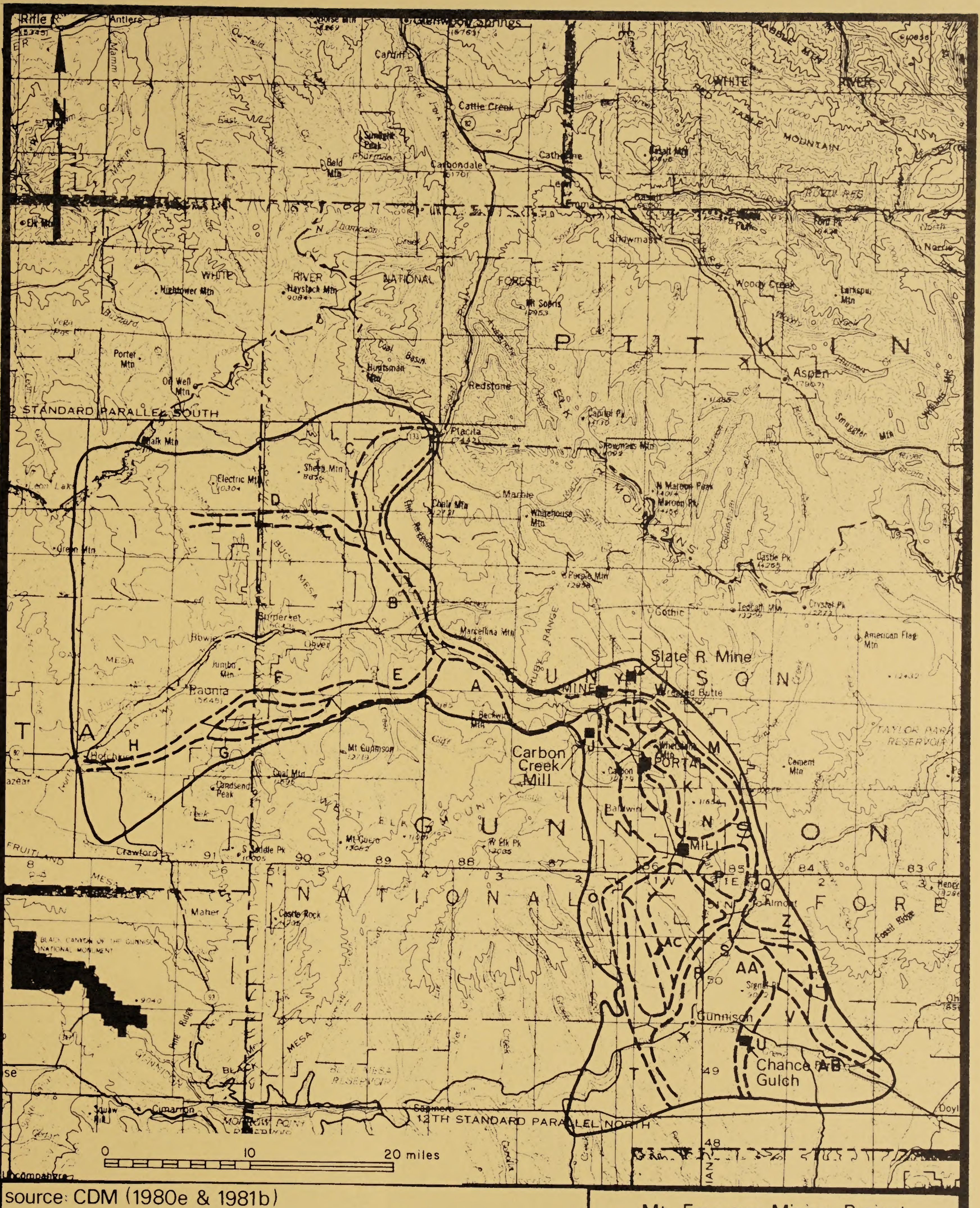
August 1981

FIG. D-1

POSSIBLE POWER SOURCES, CORRIDOR ANALYSIS and MAJOR ENVIRONMENTAL CONSTRAINT AREAS

source: CDM (1980e)

LEGEND
CORRIDOR ANALYSIS AREAS
POWER FACILITIES
EXISTING
PLANNED
WILDERNESS
N
0
10
20 miles
SHOSHONE POWER PLANT 15 MW
Glenwood Springs
TO WALCOTT
TO CRAIG
Rifle
PSC WAPA SUB
CU SUB
CU 138 KV
230 KV
PSC 230 KV
HOPKINS SUB
CU 115 KV
WHITE RIVER NATIONAL FOREST
CARBONDALE SUB
BASALT SUB
PSC 115 KV
PSC 230 KV
TABLE MOUNTAIN
BATTLEMENT MESA
PSC 69 KV
CU 69 KV, 115 KV
WAPA 30 KV
CU 345 KV (PLANNED)
2D STANDARD PARALLEL SOUTH
PITKIN
ASPEN SUB
MAROON BELLS SNOWMASS WILDERNESS
HUNTER FRYINGPAN WILDERNESS
MALTA SUB
WAPA 230 KV
TWIN LAKES POWER PLANT
LAKE
PARK
RAGGEDS WILDERNESS
COLLEGIATE PEAKS WILDERNESS
MINE
MINE
GCEA C.B. SUB
MILL
PORTAL
GUNNISON
Orchard City
DELTA
WEST ELK WILDERNESS
GUNNISON NATIONAL FOREST
MILL
GCEA 69 KV
PSC 115 KV
CU 345 KV (PLANNED)
CHAFFEE
Buena Vista
Taylor Park Reservoir
LOST CANYON
WAPA 115 KV
GCEA SKITO SUB
MILL
Gunnison
PONCHA SUB
PSC 115 KV
WAPA 230 KV
Salida
TO MIDWAY SUB
WAPA 230 KV
WAPA 115 KV
MORROW POINT
BLUE MESA POWER PLANT 69 MW
CURECANTI SUB
12TH STANDARD PARALLEL NORTH
WAPA 115 KV
TO FOUR CORNERS
CU 115 KV
WAPA 230 KV
Montrose



N
Rifle
Antlers
Glenwood Springs
Cardiff
Cattle Creek
Carbondale
Catherine
Emma
Snowmass
Woody Creek
WHITE RIVER
TABLE MOUNTAIN
WHITE RIVER NATIONAL FOREST
Haystack Mtn
Mt Sopris
Hightower Mtn
Porter Mtn
Oil Well Mtn
Coal Basin
Huntsman Mtn
Redstone
Aspen
P I T K I N
STANDARD PARALLEL SOUTH
Placita
Electric Mtn
Sheep Mtn
Chair Mtn
Marble
Whitehouse Mtn
Snowmass Mtn
N Maroon Peak
Maroon Pk
Capitol Pk
Castle Pk
Purple Mtn
Gothic
Teocalli Mtn
Crystal Pk
American Flag Mtn
Marcellina Mtn
Somerset
Bowie
Jumbo Mtn
Paonia
Hotchkiss
Slate R. Mine
MINE
Carbon Creek Mill
PORTAL
MILL
Mt Gunnison
Coal Mtn
Landsend Peak
Mt Guero
W Elk Pk
Saddle Pk
Crawford
Castle Rock
Maher
Almont
Taylor Park Reservoir
Cement Mtn
G U N N I S O N
N A T I O N A L
F O R E
Gunnison
Chance Gulch
Black Canyon of the Gunnison National Monument
Blue Mesa Reservoir
Cimarron
Sapinero
12TH STANDARD PARALLEL NORTH
A
B
C
D
E
F
G
H
I
J
K
L
M
N
O
P
Q
R
S
T
U
V
W
X
Y
Z
AA
AB
AC
0
10
20 miles

source: CDM (1980e & 1981b)

LEGEND

———	CORRIDOR ANALYSIS AREA BOUNDARY
– – –	ALTERNATIVE TRANSMISSION LINE CORRIDORS
K	ALTERNATIVE CORRIDOR SEGMENT DESIGNATION

Mt. Emmons Mining Project

ALTERNATIVE TRANSMISSION LINE CORRIDORS

July 1981

FIG. D-2

Appendix E. Land Classification Details

APPENDIX E: LAND CLASSIFICATION DETAILS

INTRODUCTION

Parcels of land proposed for inclusion in a land exchange must be classified for the purpose before an exchange can be executed. If the parcels are part of the National Forest System (NFS) and the Forest Service concludes it is in the public interest to dispose of them, they must be classified for disposal before they can be exchanged. Conversely, if they are under other ownership and the Forest Service concludes it is in the public interest to acquire them, they must be classified for acquisition. Land classifications are determined by the Regional Forester, with Forest Supervisors recommending what classifications should be.

AMAX has purchased lands within the external boundaries of several National Forests in Colorado which it is offering in exchange for the parcels it wishes to obtain for the Mt. Emmons Project. Some of these parcels are not currently classified for acquisition by the Forest Service. Similarly, the parcels AMAX wishes to obtain are not currently classified for disposal.

This appendix contains detailed maps (Figures E-1 through E-10) of the affected parcels. These maps show both the current classifications and the ones proposed which are needed to allow the exchange to be completed if desired.

LAND CLASSIFICATION ALTERNATIVES (Alternatives 2 and 3)

The Forest Supervisors of the National Forests involved have decided to recommend that the current classifications on their Forests be modified because of changes in land management situations and based on the long-term public interest. The alternatives available to the Regional Forester are: (1) approve changing the existing classifications in accordance with the proposed classifications contained in this Appendix; or (2) not approve these changes.

Regarding the lands AMAX wishes to obtain on the Gunnison National Forest, the proposed classification change is to be considered an interim classification which includes the maximum area the Forest Service would consider for disposal. If subsequent environmental analysis on this land exchange determines that it is not desirable to dispose of the total areas displayed here, then the recommended classification change may be revised. Classification of the offered lands may also be revised as land management situations change.

LAND CLASSIFICATION PROCEDURES

The fundamental objectives of the land classification process are: (1) to identify non-federal lands that are suitable for National Forest purposes and which would find their best use if developed as part of the NFS, and (2) to determine those lands that should be deleted from the NFS with the intent of seeking the optimum landownership pattern. To arrive at this pattern, consideration is given to the following:

(1) Protection and improvement of the environment including soil, water, air, vegetation, fish, wildlife, and natural beauty;

(2) Achievement of a balance of resource uses from both public and private lands that will best meet present and future national, regional, and local needs;

(3) Encouragement of local development, including growth of forest, recreation, range, and mining-based enterprises;

(4) Public wants and needs determined through public involvement by seeking public advice at the national, state, and local levels;

(5) Needs of other federal agencies and state and local governments; and

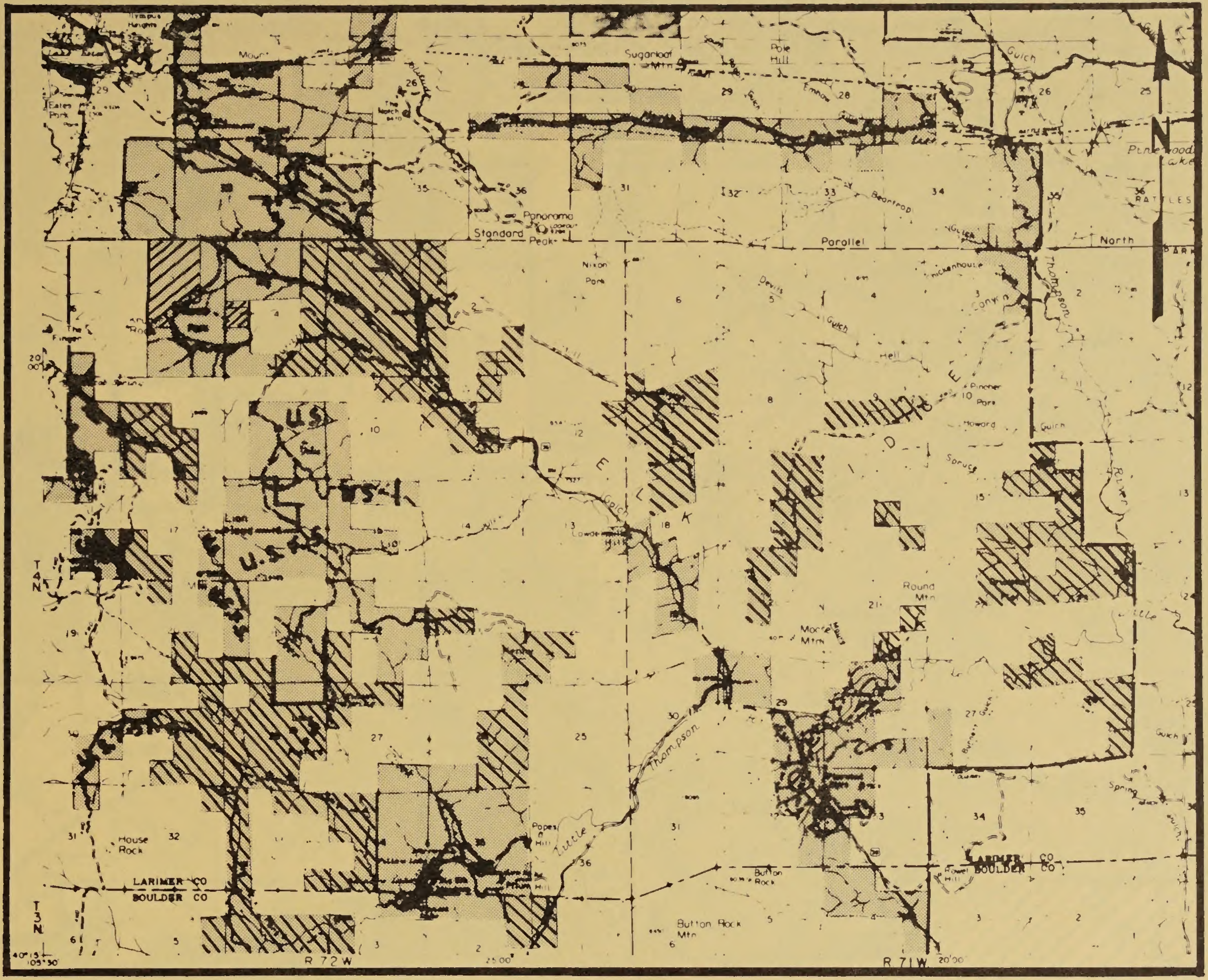
(6) State and county responsibilities for land use planning and zoning.

The term "classification", as used here, means the act of determining through analysis and documented study the lands which are most suitable for NFS purposes and NFS lands which are most suitable for other ownerships. Classification for landownership purposes and the act of landownership adjustment are closely related, but definitely separate, activities. Classification involves determining the optimum ownership pattern considering the need, suitability, and possible limitations on use. Landownership adjustments involve the actual process of changing ownership to achieve the ownership pattern approved in land management plans or classification studies. The programs of exchange, transfer, purchase, etc., and the establishment of priorities, are functions of landownership adjustment, not of classification.

Classification is a prerequisite to landownership adjustments. Classification planning should reflect the ownership determined to be in the public interest in the long run and should not be limited by current adjustment possibilities. Generally, adjustments will be worked out over a period of years on a case-by-case basis in accordance with approved plans.

RECLASSIFICATION JUSTIFICATION

Long range land classification for landownership adjustment needs was not adequately reflected or studied in the original Forest classification plans, nor was it updated in the East River Unit Management Plan to facilitate current resource management direction. Thus amendments are required and necessary. The primary document used to indicate a need for changes in management direction and land classification is AMAX's Plan of Operations (AMAX 1979a, 1980a, and 1981a).


Sugarloaf Mtn
Pole Hill
Panorama
Standard Peak
Nixon Park
Parallel
North
Pinewood Lake
Devils Gulch
Hell
Pincher Park
Spruce
Round Mtn
Mocle Mtn
Thompson
Little
Popes Hill
House Rock
LARIMER CO
BOULDER CO
Button Rock
Button Rock Mtn
T 4 N
T 3 N
R 72 W
R 71 W
N
U.S.

LEGEND

▩ PRIVATE LAND INSIDE NATIONAL FOREST BOUNDARY

▨ DISPOSAL AREAS

▧ ACQUISITION AREAS

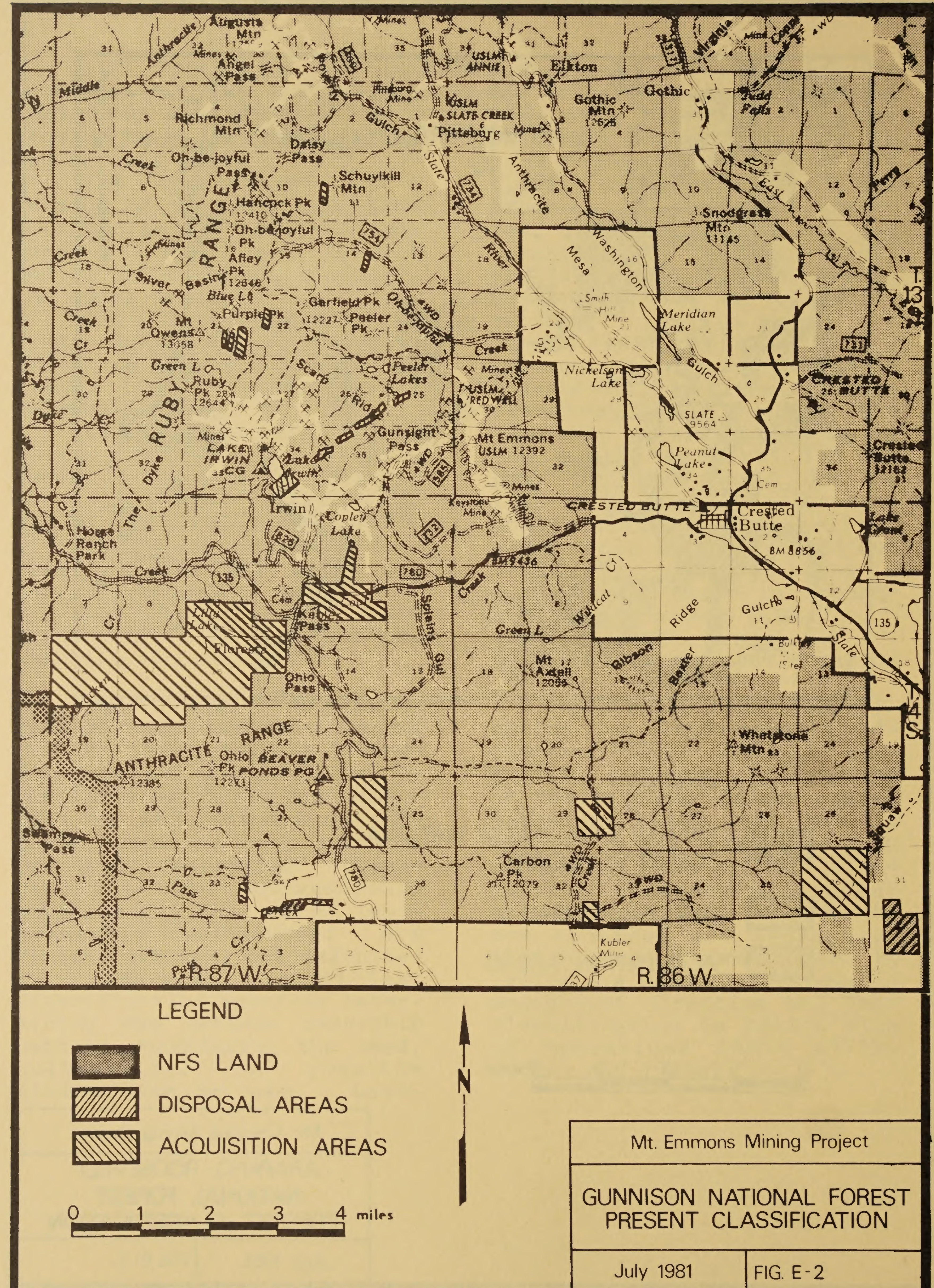
0 1 2 3 4 miles

Mt. Emmons Mining Project

ARAPAHO-ROOSEVELT
NATIONAL FOREST
PRESENT CLASSIFICATION

July 1981

FIG. E-1

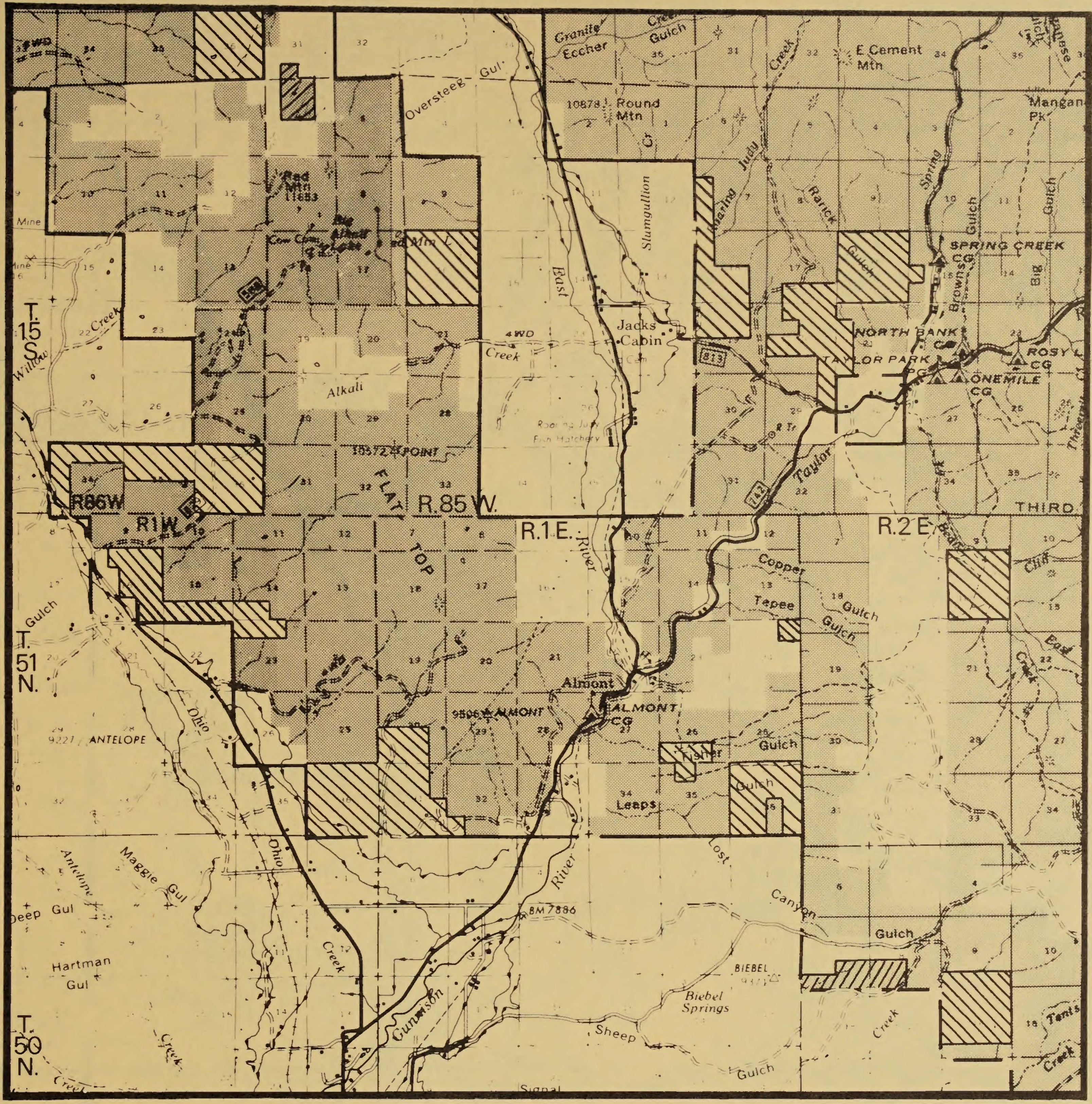

LEGEND
▩ NFS LAND
▨ DISPOSAL AREAS
▧ ACQUISITION AREAS
0 1 2 3 4 miles
N
Augusta Mtn
Angel Pass
Elkton
Gothic
Gothic Mtn 12625
Richmond Mtn
Pittsburg
Daisy Pass
Oh-be-joyful Pass
Schuylkill Mtn
Hancock Pk 12410
Oh-be-joyful Pk
Afley Pk 12646
RUBY RANGE
Purple Pk
Garfield Pk
Mt Owens 13058
Peeler Pk
Ruby Pk 12644
Peeler Lakes
Gunsight Pass
Mt Emmons USLM 12392
Snodgrass Mtn 11145
Washington Mesa
Meridian Lake
Nickelson Lake
Peanut Lake
SLATE 9564
Crested Butte
BM 8856
Crested Butte 12162
Lake Irwin
Irwin
Copley Lake
Horse Ranch Park
Kebler Pass
Ohio Pass
Mt Axtell 12055
Whetstone Mtn
ANTHRACITE RANGE
Ohio Pk 12271
BEAVER PONDS PG
Swampy Pass
Carbon Pk 12079
Kubler Mine
135
780
R.87 W.
R.86 W.
T. 13 S.
T. 14 S.

Mt. Emmons Mining Project

GUNNISON NATIONAL FOREST
PRESENT CLASSIFICATION

July 1981

FIG. E-2


Granite
Eccher
Creek
Gulch
E Cement Mtn
10878 Round Mtn
Oversteeg Gul
Mangan Pk
Red Mtn 11653
Big Alkali Creek
Cow Crk
Mine
Slumgullion
Roaring Judy
Rarick
Gulch
Spring
Browns
Big Gulch
SPRING CREEK CG
NORTH BANK CG
TAYLOR PARK CG
ROSY L CG
ONEMILE CG
East
Jacks Cabin
4WD Creek
813
T. 15 S.
Willow Creek
Alkali
10572 POINT
FLAT TOP
R.85 W.
R86W
R1W
R.1 E.
R.2 E.
THIRD
742
Taylor
River
Copper
Tepee
Gulch
Gulch
Cliff
East Creek
Gulch
T. 51 N.
Almont
9506 ALMONT
ALMONT CG
9227 ANTELOPE
Ohio
Fisher
Gulch
Leaps
Gulch
Lost
Canyon
Gulch
Antelope
Maggie Gul
Deep Gul
Hartman Gul
Ohio
Creek
River
BM 7886
Gunnison
BIEBEL
Biebel Springs
Sheep
Gulch
Creek
Tents Creek
T. 50 N.
Creek
Signal

LEGEND

▨ DISPOSAL AREAS

▨ ACQUISITION AREAS

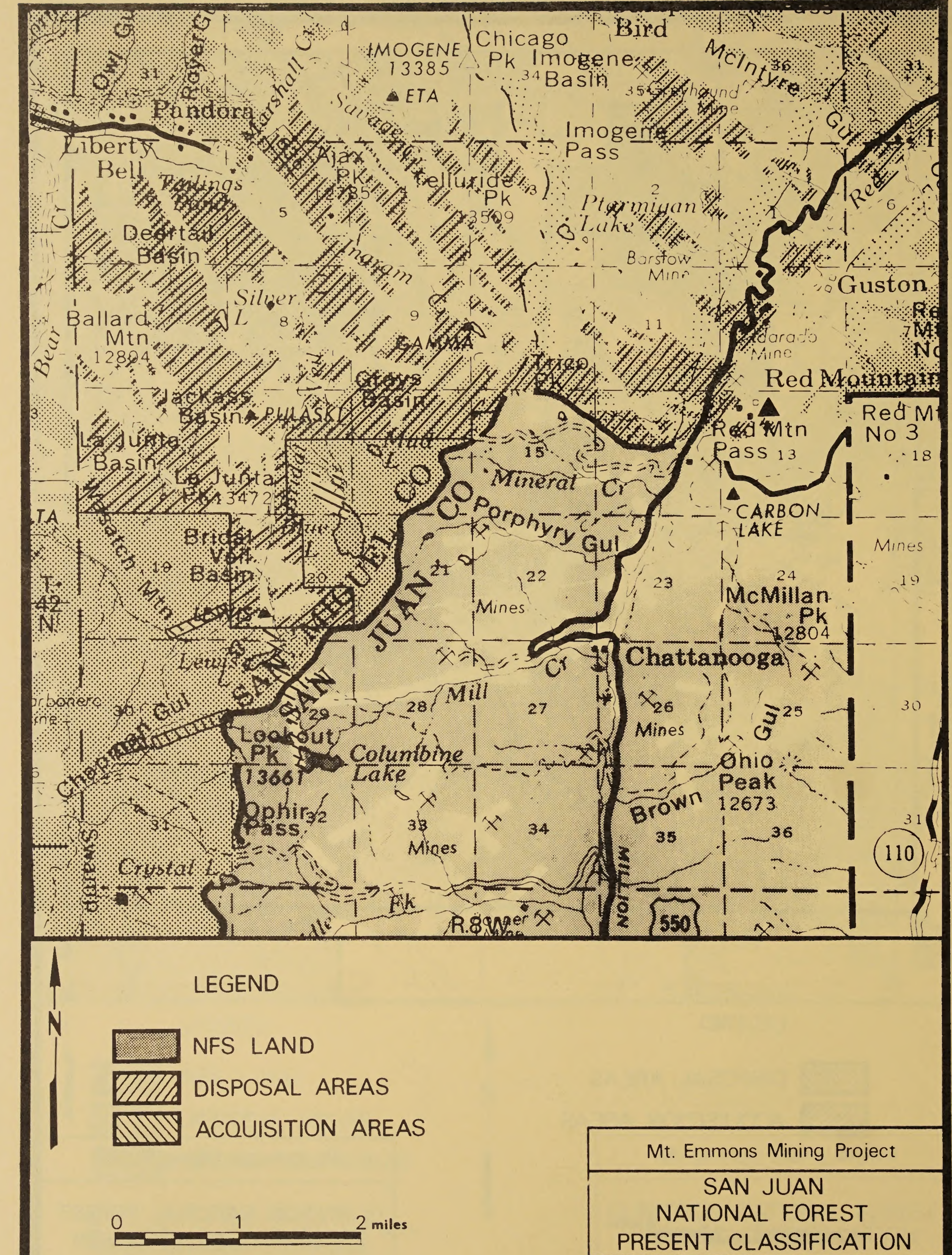
0 1 2 3 4 miles

N

Mt. Emmons Mining Project

GUNNISON NATIONAL FOREST
PRESENT CLASSIFICATION

July 1981 FIG. E-3

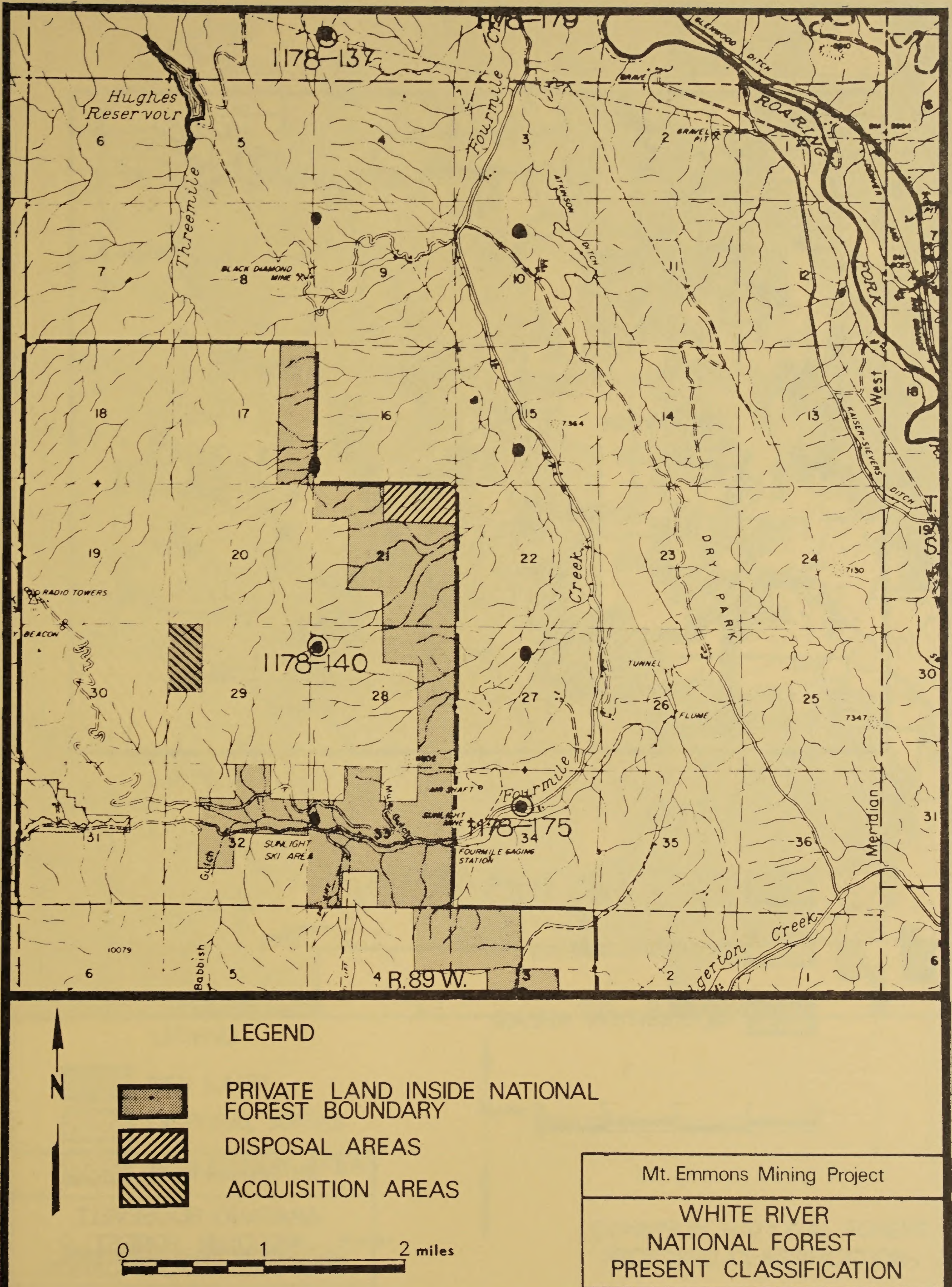

Pandora
Liberty Bell
Tailings
Deertail Basin
Ballard Mtn 12804
Jackass Basin
PULASKI
La Junta Basin
La Junta Pk 13472
Bridal Veil Basin
Wasatch Mtn
Lewis
Chapman Gul
Lookout Pk 13661
Columbine Lake
Ophir Pass
Crystal L
IMOGENE 13385
ETA
Chicago Pk
Imogene Basin
Imogene Pass
Ajax Pk 12785
Telluride Pk 13509
Savage
Marshall Cr
Ingram
Silver L
GAMMA
Grays Basin
Mud L
Trico Pk
Ptarmigan Lake
Barstow Mine
Greyhound Mine
McIntyre Gul
Bird
Guston
Idarado Mine
Red Mountain
Red Mtn Pass
Red Mt No 3
CARBON LAKE
Mineral Cr
Porphyry Gul
SAN MIGUEL CO
SAN JUAN CO
Mines
McMillan Pk 12804
Chattanooga
Mill Cr
Ohio Peak 12673
Brown Gul
MILLION
550
110
T. 42 N.
R.8W.
N
LEGEND
NFS LAND
DISPOSAL AREAS
ACQUISITION AREAS
0
1
2 miles

Mt. Emmons Mining Project

SAN JUAN
NATIONAL FOREST
PRESENT CLASSIFICATION

July 1981

FIG. E-4

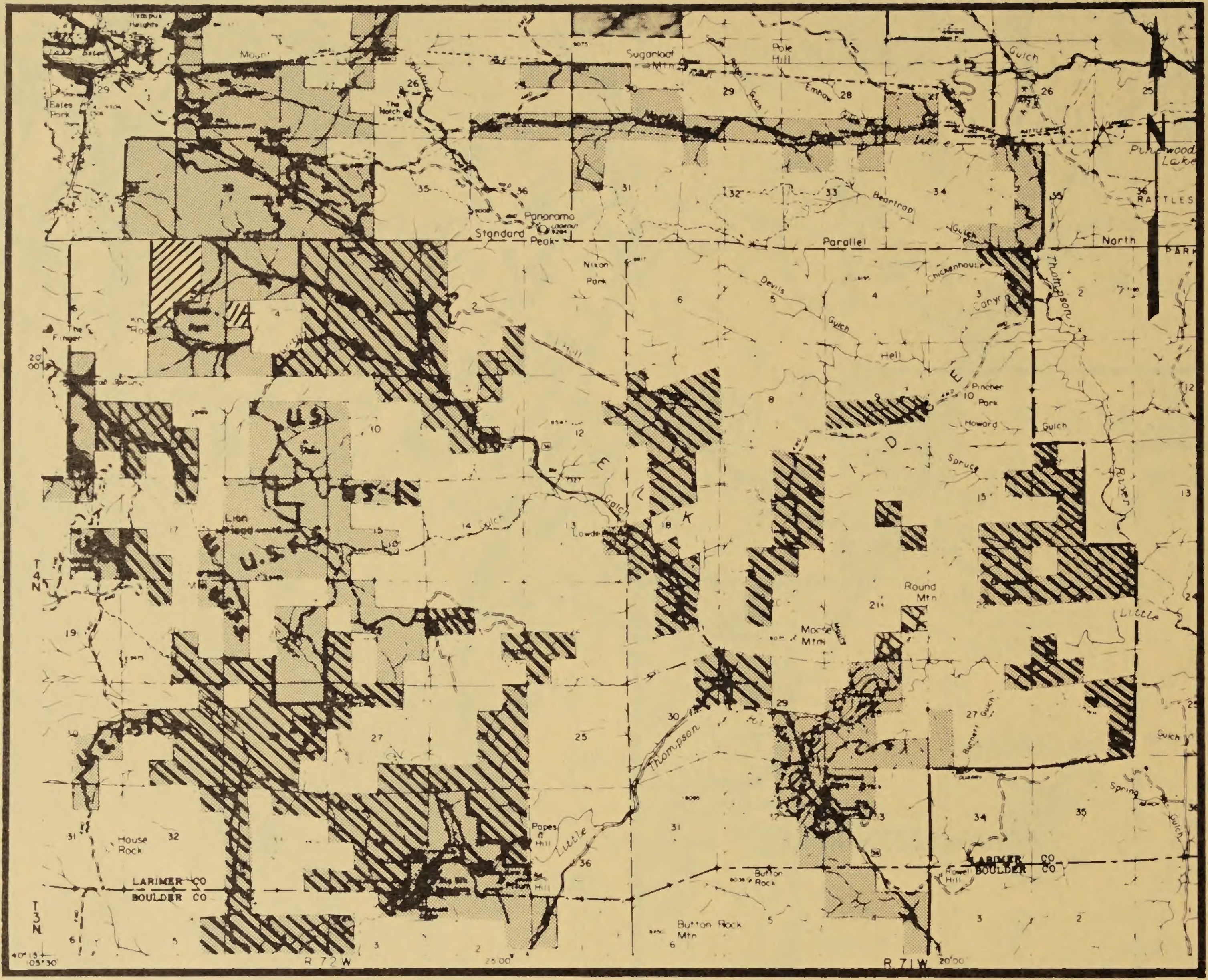

1178-137
1178-140
1178-175
Hughes Reservoir
Threemile
Black Diamond Mine
Fourmile Creek
Atkinson Ditch
Glenwood Ditch
Roaring Fork
Gravel Pit
Kaiser-Sievers Ditch
West Meridian
Dry Park
Tunnel
Flume
Radio Towers
Beacon
Sunlight Ski Area
Sunlight Mine
Air Shaft
Fourmile Gaging Station
Gulch
Babbish
Egerton Creek
R.89 W.
LEGEND
N
PRIVATE LAND INSIDE NATIONAL FOREST BOUNDARY
DISPOSAL AREAS
ACQUISITION AREAS
0
1
2 miles

Mt. Emmons Mining Project

WHITE RIVER
NATIONAL FOREST
PRESENT CLASSIFICATION

July 1981

FIG. E-5


Suganloaf Mtn
Pole Hill
Panorama Peak
Standard Parallel
North
Nixon Park
Devils Gulch
Hell
Pincher Park
Howard Gulch
Spruce
U.S.
U.S.F.S.
Lion Head
Lowden
Round Mtn
Mocre Mtn
Thompson
Little Thompson
Popes Hill
House Rock
LARIMER CO
BOULDER CO
Button Rock
Button Rock Mtn
T 4 N
T 3 N
R 72 W
R 71 W
N

LEGEND

▨ PRIVATE LAND INSIDE NATIONAL FOREST BOUNDARY

▨ DISPOSAL AREAS

▧ ACQUISITION AREAS

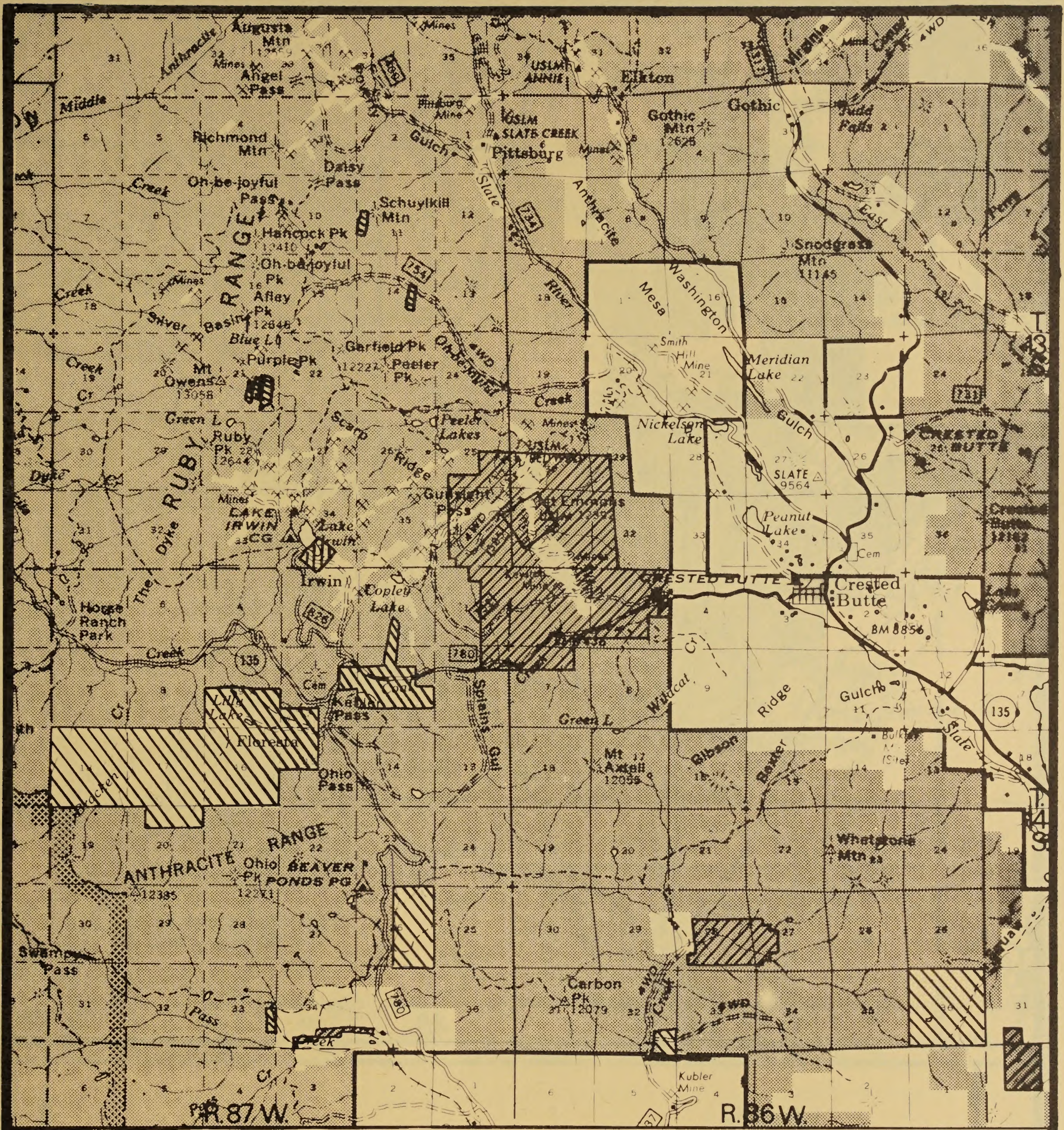
0 1 2 3 4 miles

Mt. Emmons Mining Project

ARAPAHO-ROOSEVELT
NATIONAL FOREST
PROPOSED CLASSIFICATION

July 1981

FIG. E-6


Augusta Mtn
Angel Pass
Middle
Anthracite
USLM ANNIE
Elkton
Gothic
Gothic Mtn 12625
Judd Falls
Pittsburg Mine
USLM SLATE CREEK
Pittsburg
Slate River
Gulch
Richmond Mtn
Daisy Pass
Oh-be-joyful Pass
Creek
Schuylkill Mtn
Hancock Pk 12410
Oh-be-joyful Pk
Afley Pk 12646
RUBY RANGE
Silver Basin
Blue L
Purple Pk
Garfield Pk 12222
Peeler Pk
Mt Owen 13058
Green L
Ruby Pk 12644
Scarp Ridge
Peeler Lakes
Snodgrass Mtn 11145
East
Washington Mesa
Smith Hill Mine
Meridian Lake
Nickelson Lake
Gulch
SLATE 9564
Peanut Lake
Cem
CRESTED BUTTE
Crested Butte
BM 8856
Mt Emmons
Gunsight Pass
4WD
LAKE IRWIN CG
Lake Irwin
Irwin
Copley Lake
The Dyke
Horse Ranch Park
Creek
Kebler Pass
Lily Lake
Floresta
Ohio Pass
Splains Gul
Wildcat Cr
Ridge
Gulch
Green L
Mt Axtell 12055
Gibson
Baxter
Whetstone Mtn
ANTHRACITE RANGE
Ohio Pk 12271
BEAVER PONDS PG
12385
Swampy Pass
Pass
Carbon Pk 12079
Kubler Mine
135
780
T. 14 S.
T. 13 S.
R. 87 W.
R. 86 W.

LEGEND

▒ NFS LAND

▨ DISPOSAL AREAS

▧ ACQUISITION AREAS

N

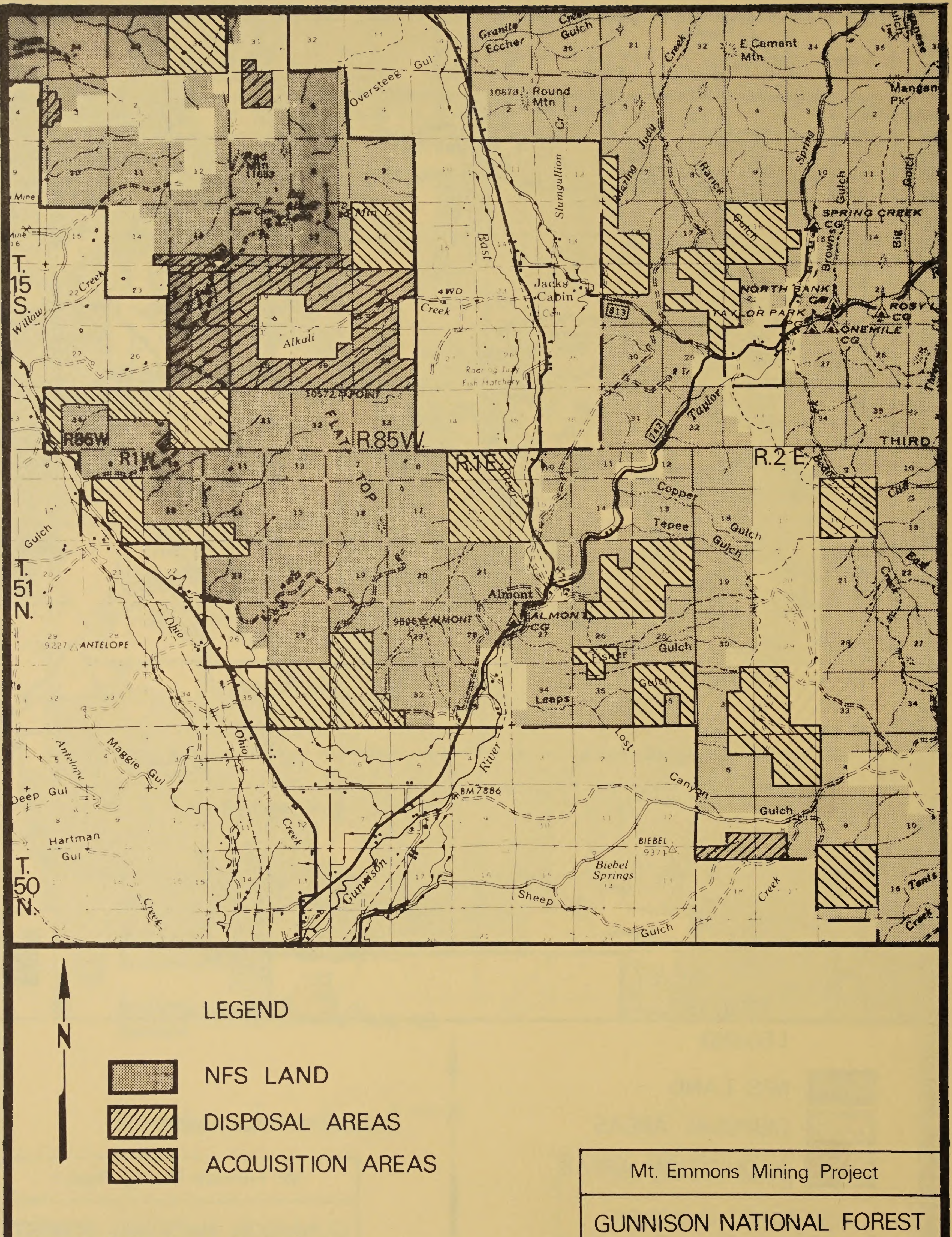
0 1 2 3 4 miles

Mt. Emmons Mining Project

GUNNISON NATIONAL FOREST
PROPOSED CLASSIFICATION

July 1981

FIG. E-7

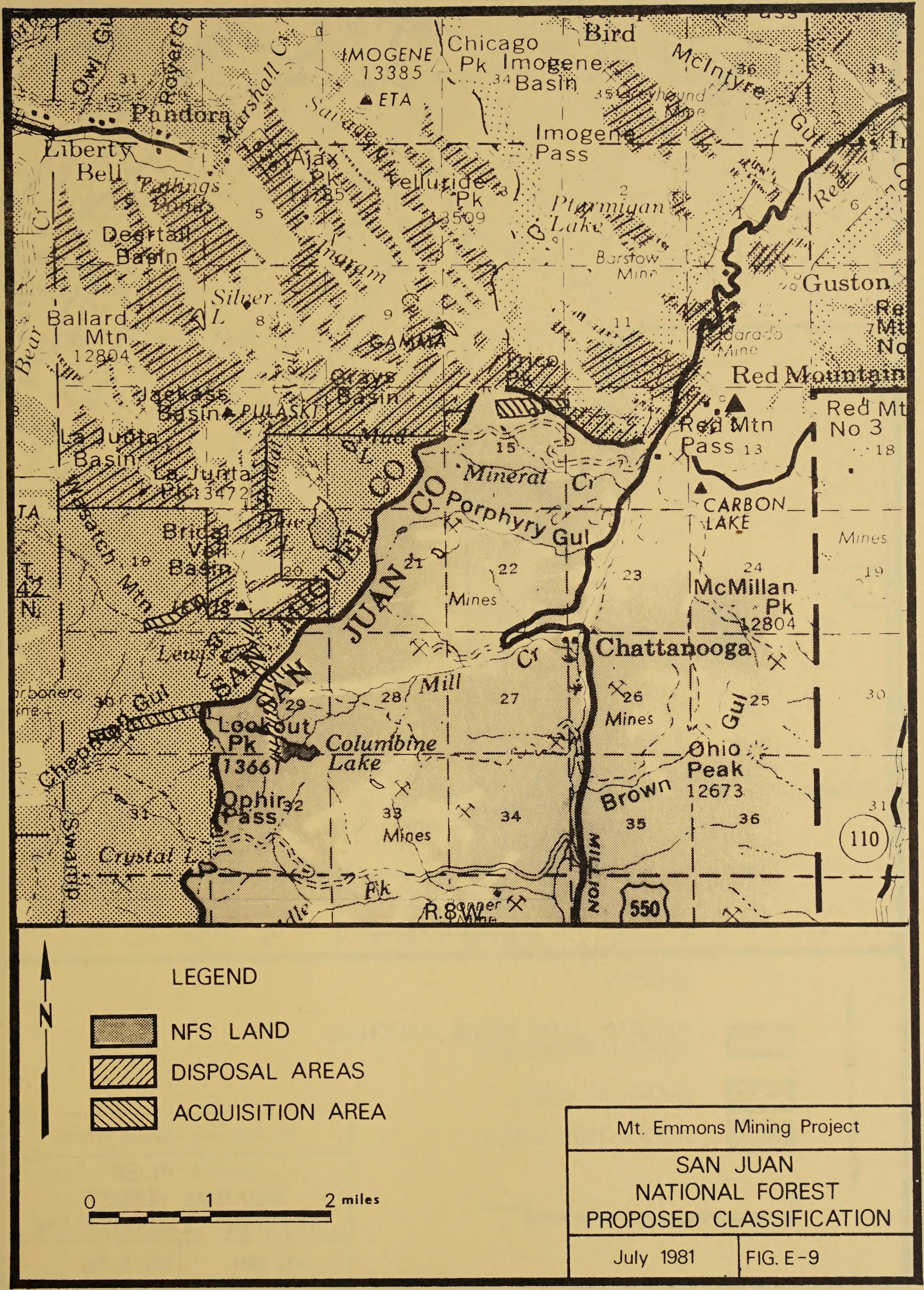

LEGEND
NFS LAND
DISPOSAL AREAS
ACQUISITION AREAS
N
0 1 2 3 miles
T. 15 S.
T. 51 N.
T. 50 N.
R.85W.
R86W
R1W
R.1E.
R.2 E.
THIRD
Granite
Eccher
Creek Gulch
E Cement Mtn
10878 Round Mtn
Oversteeg Gul
Red Mtn 11633
Mangan Pk
Judy Creek
Ranck
Spring Creek
Browns Gulch
Big Gulch
SPRING CREEK CG
NORTH BANK CG
TAYLOR PARK
ROSY CG
ONEMILE CG
Slumgullion
East
Jacks Cabin
4WD Creek
Alkali
Roaring Judy Fish Hatchery
10572 FLAT POINT
FLAT TOP
813
742
Taylor
Copper
Tepee
Gulch
Willow Creek
Mine
Gulch
ANTELOPE
9227
Ohio
Almont
ALMONT CG
9596 ALMONT
Fisher
Gulch
Leaps
Lost Canyon
Gulch
Antelope
Maggie Gul
Deep Gul
Hartman Gul
Ohio Creek
Gunnison
River
BM 7886
BIEBEL 9371
Biebel Springs
Sheep
Gulch
Creek
Tents
East Creek

Mt. Emmons Mining Project

GUNNISON NATIONAL FOREST
PROPOSED CLASSIFICATION

July 1981

FIG. E-8

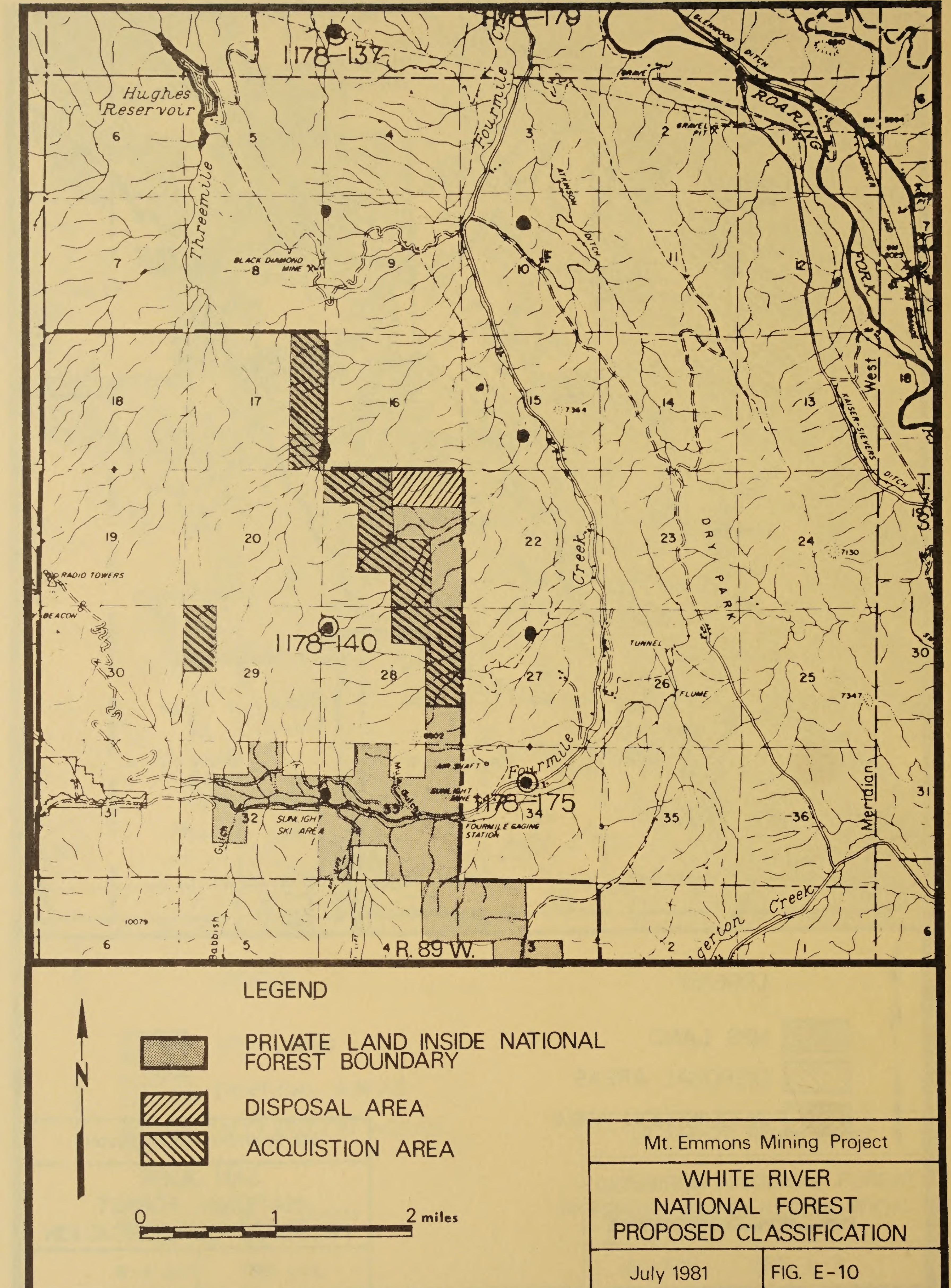

Owl Gu
Royer G
Pandora
Liberty Bell
Marshall Cr
Bear Cr
Bridal Veil Falls
Deertail Basin
Silver L
Ballard Mtn 12804
Jackass Basin
PULASKI
La Junta Basin
La Junta Pk 13472
Wasatch Mtn
Bridal Veil Basin
T. 42 N.
Lewis Cr
Carbonero Mine
Chapman Gul
Swamp
Crystal L
IMOGENE 13385
ETA
Savage Crk
Ajax Pk 12785
Telluride Pk 13509
Ingram
Gray's Basin
GAMMA
Trico Pk
Mud L
Blue L
Chicago Pk
Imogene Basin
Imogene Pass
Bird
Greyhound Mine
McIntyre Gul
Ptarmigan Lake
Barstow Mine
Guston
Red Cr
Idarado Mine
Red Mountain
Red Mtn No 3
Red Mtn Pass
CARBON LAKE
Mines
McMillan Pk 12804
Mineral Cr
Porphyry Gul
SAN MIGUEL CO
SAN JUAN CO
Chattanooga
Mill Cr
Lookout Pk 13661
Columbine Lake
Ophir Pass
Ohio Peak 12673
Brown Gul
Mines
Fk
R.8W.
Mine
MILTON
550
110
LEGEND
N
NFS LAND
DISPOSAL AREAS
ACQUISITION AREA
0
1
2 miles

Mt. Emmons Mining Project

SAN JUAN NATIONAL FOREST PROPOSED CLASSIFICATION

July 1981

FIG. E-9


Hughes Reservoir
Threemile
Fourmile Cr.
Fourmile Creek
Atkinson Ditch
Black Diamond Mine
Glenwood Ditch
Roaring Fork
West
Kaiser-Sievers Ditch
Gravel Pit
Dry Park
Tunnel
Flume
Radio Towers
Beacon
Air Shaft
Sunlight Mine
Sunlight Ski Area
Fourmile Gaging Station
Muddy Gulch
Babbish Gulch
Meridian
Creek
1178-137
1178-179
1178-140
1178-175
R. 89 W.
T. 7 S.
7364
7130
7347
10079
8802
LEGEND
N
PRIVATE LAND INSIDE NATIONAL FOREST BOUNDARY
DISPOSAL AREA
ACQUISTION AREA
0
1
2 miles

Mt. Emmons Mining Project

WHITE RIVER
NATIONAL FOREST
PROPOSED CLASSIFICATION

July 1981

FIG. E-10

Appendix F. Land Exchange Details

APPENDIX F: LAND EXCHANGE DETAILS

INTRODUCTION

The action of land exchange is at the discretion of the federal agency charged with responsibility for managing the affected lands. Although exchange does require a willing proponent, it cannot be consummated without the agreement of the agency, in this case the Forest Service.

Chapter 1 describes the nature of the final Forest Service land exchange decision. This EIS provides data and analysis of the land exchange proposal so that the effects of proceeding with analysis of AMAX's land exchange offer, (Alternatives 2 and 3) can be compared against the effects of not proceeding with it. The latter would terminate the process. The former will lead to more intensive analysis of exchange alternatives in terms of the public interest. Section 206 of the Federal Land Policy and Management Act of 1976 (FLPMA) requires that the authorized official determine whether the public interest will be well served by the proposed exchange. It further requires that full consideration be given to better federal land management and the needs of state and local people, including needs for lands for the economy, community expansion, recreation areas, food, fiber, minerals, and fish and wildlife.

All of the information required for further analysis is not available at this time, but in order to provide a basis for public comment on the nature of subsequent analysis, this appendix describes some of the alternatives that may be considered. If the decision is made to proceed with environmental analysis, the public benefit of the following alternatives may be evaluated.

(The following discussion deals only with the Alkali Creek area for milling and tailing disposal. Should either Carbon Creek or Chance Gulch ultimately become the location actually used, substitute land exchange offers may be made. Other alternatives may then arise, including ones of interest to the BLM.)

FOREST SERVICE OPTIONS (Alternatives 2 and 3)

The Forest Service has several options regarding the land exchange. It may accept AMAX's offer, amend it, not accept it, or acquire the offered lands through Land Water Conservation Fund purchases.

Accept AMAX's Offer (Alternatives 2 and 3)

AMAX has identified 7,587 acres, more or less and subject to change, in two exchange offers. These areas involve National Forest System lands in Gunnison County, Colorado, which AMAX wishes to acquire in connection with the Mt. Emmons Project. See Chapter 2. These offers include: 2,793 acres for the Coal Creek mine site and the north portal of the Mt. Axtell tunnel, 188 acres for the south portal of the Mt. Axtell tunnel and Carbon Creek reservoir site, 4,532 acres for the Alkali Creek mill site, and 74 acres for the north portal of the Red Mountain tunnel. If the exchanges are approved, AMAX will obtain fee title to these lands subject to reservations by the United States (1) under the Reservation for Ditches and Canals Act of August 30, 1890 (26 Stat. 391), and (2) for rights-of-way for public road access across the selected lands.

In exchange for these lands, AMAX has offered the Forest Service 9,807 acres of private land located within six National Forest boundaries in ten Colorado counties as summarized in Table F-1. These acreages are subject to change based on final selected acreages and appraisal conclusions. The offered lands have a wide variety of resource values, many of which are described in detail in a series of reports submitted by AMAX (Glover, et. al., 1981). These reports are incorporated by reference for the descriptive details that they include. Figure 2-3 in Chapter 2 describes the general location of offered lands and should be used when referencing the details in the AMAX offered land reports. Figures F-1 and F-2 show in more detail the locations of the offered lands in Gunnison County.

Further analysis of AMAX's proposal may lead to the conclusion that the exchange is not in the public interest. If this occurs, exchange proceedings may be terminated.

Amend AMAX's Offer (Alternative 3)

An alternative to accepting the exchange proposals submitted by AMAX is to develop counter proposals involving the disposal of less National Forest System acreage. Although AMAX's proposals have already been amended as a result of preliminary discussions, there are several unresolved issues which could be further addressed by additional amendments to the current proposals. These issues are discussed below.

<ins>Mt. Emmons Iron Bog</ins> - The Iron Bog on Mt. Emmons has been identified as a unique environment (See Chapter 3). AMAX has proposed acquiring ownership of this area. One alternative which keeps the Iron Bog in the National Forest System (NFS) is shown in Figure F-3.

<ins>Crested Butte Municipal Watershed</ins> - There is public concern for maintaining the quality of water flowing from the Coal Creek watershed because it is the Town of Crested Butte's water supply. One alternative which keeps Coal Creek itself in the NFS is shown in Figure F-3. Another alternative is to not dispose of any of the NFS lands in the Coal Creek drainage by exchange. All of AMAX's activities in the drainage would be carried out under the Forest Service's mining regulations in 36 CFR 228 (formerly 36 CFR 252).

Oh-Be-Joyful Wilderness Study Area - Approximately 14 acres of the land selected for the mine site lie within this wilderness study area. The Forest Supervisor can only dispose of this acreage if the Oh-Be-Joyful study is completed and the Administration makes a recommendation to Congress that it is unsuitable for wilderness. An alternative shown in Figure F-3 avoids land disposal within this study area.

Sensitive Wildlife Habitats - Included in the Alkali Creek mill site selected land boundary are aspen stands that have been identified as sensitive big game habitat. (See Chapter 3). Because of public and management concerns of protecting wildlife and its limiting habitat, an exchange alternative which retains public ownership of the most sensitive big game habitat is shown in Figure F-4.

Favorable Flows - The selected land on Carbon Creek will be used (1) as a starting point for driving the Mt. Axtell tunnel, and (2) as a site for a potable water reservoir. A reservoir at this location could interfere with the maintenance of favorable conditions of flow in Carbon Creek. Reduction of Carbon Creek flows below natural low-flow levels would probably damage the existing fishery because late-season flows are already quite low. If AMAX acquires the reservoir site through land exchange, the Forest Service's opportunities to regulate releases will be diminished. An alternative is to keep the Carbon Creek Reservoir site in the NFS.

Further analysis of AMAX's proposal, even if modified to resolve some of the above issues, may lead to the conclusion that the exchange is not in the public interest. If this occurs, exchange proceedings may be terminated.

Do Not Accept AMAX's Offers

Under this alternative, NFS lands could still be made available to AMAX for its Mt. Emmons operations. In lieu of exchanging land, the Forest Service could issue special use permits or easements. The Forest Service would retain jurisdiction over the lands and could establish environmental and administrative controls over AMAX's activities.

Chapter 2, page 43, explains why this alternative was not considered in further detail.

Make L&WCF Purchases

Some of the lands offered by AMAX may be eligible for purchase with Land and Water Conservation Fund (L&WCF) money. This is an alternative method for acquiring some of the offered lands.

Chapter 2, page 42, explains why this alternative was not considered in further detail.

AMAX OPTIONS

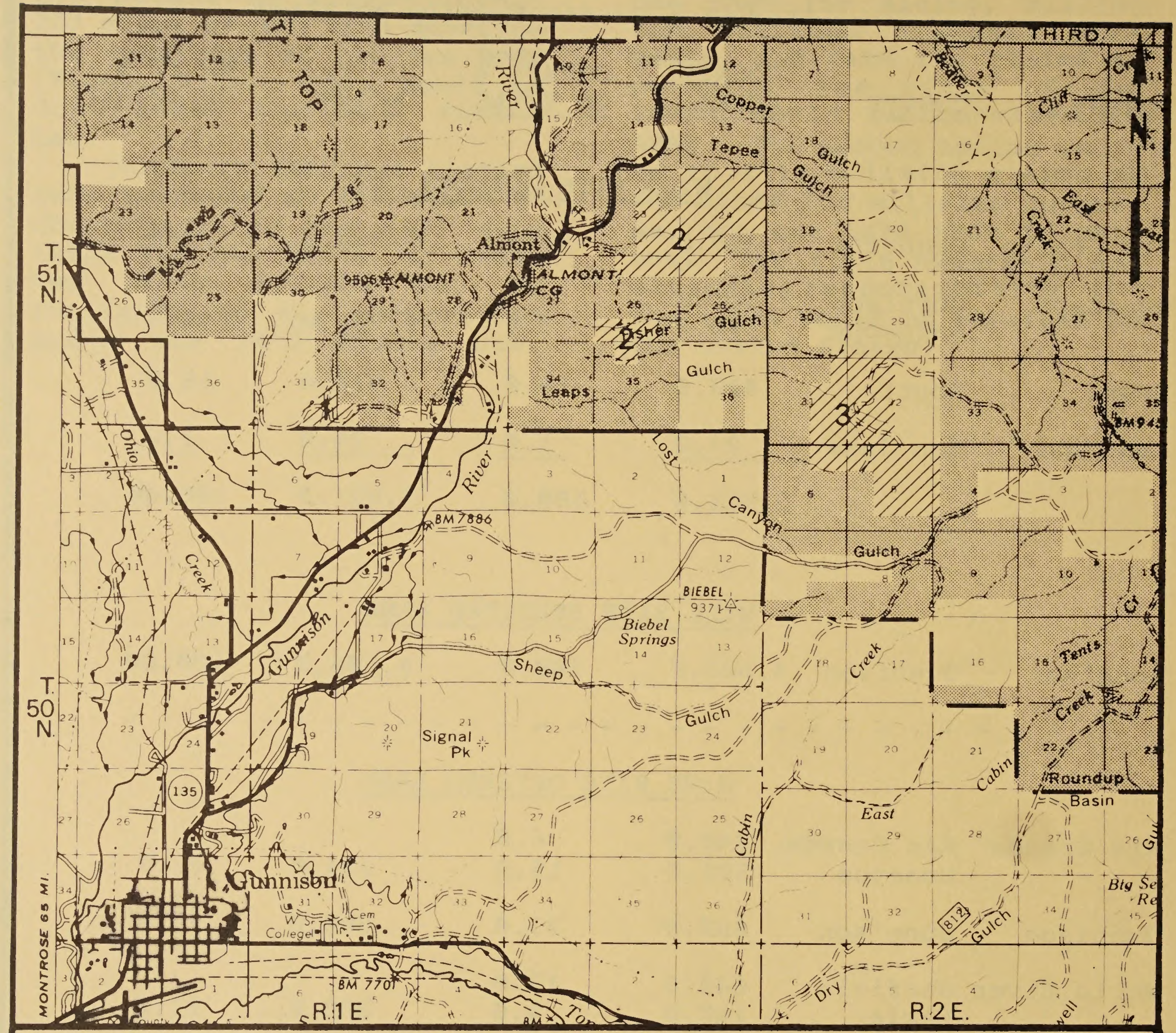
Some of the Mt. Emmons ore body lies under patented claims which AMAX already owns, and at some date AMAX will probably make application for patent on approximately 200 acres of NFS land covering the remainder of the ore body (Figure 2-2). This would be done under the 1872 Mining Law.

Although AMAX has elected land exchange as the means of obtaining mine and mill site lands for its needs, at least two other options may be available to the corporation under the 1872 Mining Law. The first would be to file millsite claims on the lands, use them for mining, milling and tailings disposal purposes, and take the claims to patent. Fee title of the lands would be conveyed to AMAX. The second option would be to file millsite claims on the lands for millsite purposes, but not take them to patent. Fee title ownership and ultimate responsibility for the lands would be retained by the United States.

TABLE F-1. LAND EXCHANGE PROPOSAL: ACREAGE BY OWNERSHIP

(Forest & County Summary by Site)

FOREST	COUNTY	COUNTY ACRES	COUNTY % OF TOTAL	N. F. ACRES	N. F. % OF TOTAL
		MILL SITE OFFERED LAND			
Rio Grande	Saguache	2,256.0	38.0	2,256.0	38.0
Gunnison	Gunnison	2,561.0			
	Saguache	160.0	3.0	2,721.0	46.0
Routt	Routt	920.0	16.0	920.0	16.0
San Juan	San Juan	24.0	1.0	24.0	1.0
		5,921.0	100.0	5,921.0	100.00
		MILL SITE SELECTED LAND			
Gunnison	Gunnison	4,606.0	100.0	4,606.0	100.00
		MINE SITE OFFERED LAND			
Rio Grande	Rio Grande	240.0	6.0		
	Conejos	595.0	15.0	834.0	22.0
Gunnison	Gunnison	880.0	23.0	880.0	23.0
White River	Garfield	640.0	17.0		
	Eagle	160.0	4.0	800.0	21.0
Routt	Garfield	160.0	4.0	160.0	4.0
Roosevelt	Boulder	142.0	4.0		
	Larimer	999.0	26.0	1,141.0	29.0
Pike	Douglas	70.0	2.0	70.0	2.0
		3,885.0	100.0	3,885.0	100.00
		MINE SITE SELECTED LAND			
Gunnison	Gunnison	2,981.0	100.0	2,981.0	100.00


THIRD
Copper
Tepee
Gulch
Gulch
Almont
ALMONT CG
9506 ALMONT
Asher
Gulch
Gulch
Leaps
Lost
Canyon
Gulch
Ohio
Creek
River
Gunnison
BM 7886
BIEBEL
9371
Biebel
Springs
Sheep
Gulch
Creek
Tents
Creek
Signal
Pk
135
Gunnison
W. St.
College
Cem
BM 7701
Cabin
East
Cabin
Roundup
Basin
812
Gulch
Dry
Big Se
Re
T. 51 N.
T. 50 N.
MONTROSE 65 MI.
R.1 E.
R.2 E.
N
1
2
2
3

1. POYE TRACT
2. SILVER SPRINGS TRACT
3. ESTY TRACT

0 1 2 3 4 miles

Figure: F-1

LANDS NEAR GUNNISON IN GUNNISON COUNTY WHICH AMAX PROPOSES TO OFFER TO THE FOREST SERVICE ▨

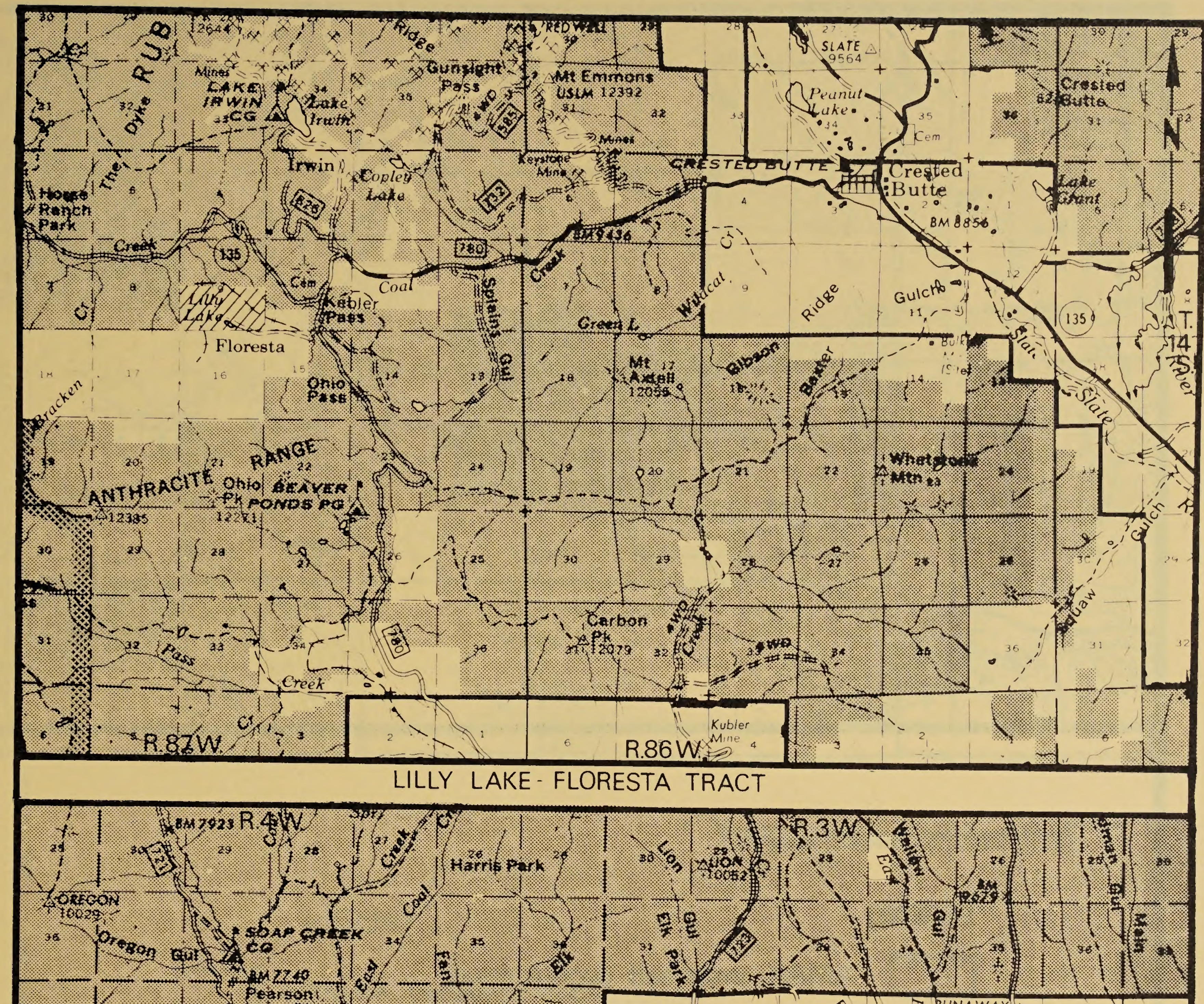
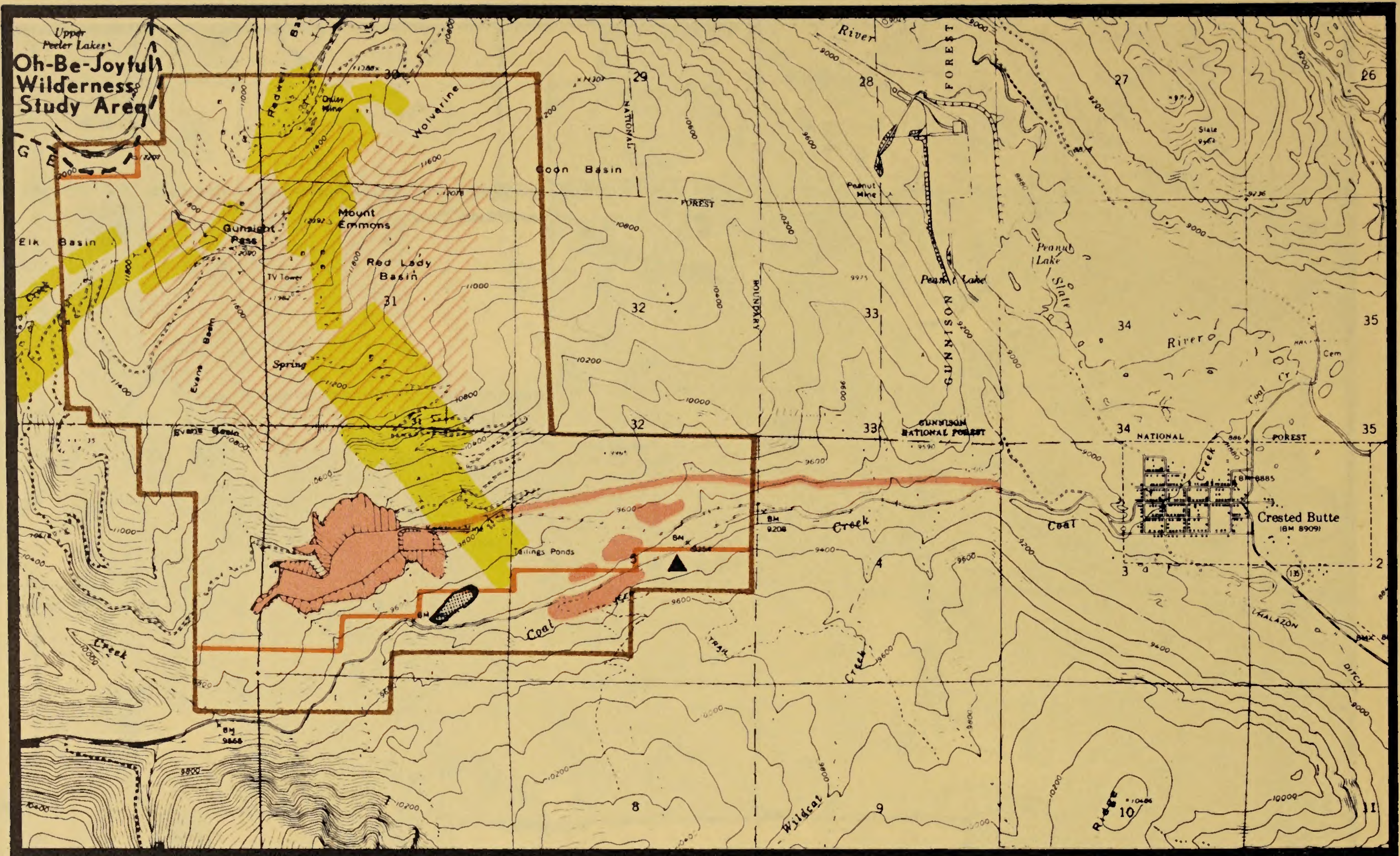

Ruby
The Dyke
Ridge
Gunsight Pass
Mt Emmons
USLM 12392
Lake Irwin
LAKE IRWIN CG
Irwin
Copley Lake
Keystone Mine
Mines
Horse Ranch Park
Crested Butte
Slate 9564
Peanut Lake
Cem
Lake Grant
BM 8856
BM 9436
Coal
Creek
Lilly Lake
Kebler Pass
Floresta
Ohio Pass
Splains Gul
Green L
Wildcat Cr
Ridge
Gulch
Mt Axtell 12055
Gibson
Baxter
Slate River
Bracken Cr
ANTHRACITE RANGE
Ohio Pk 12271
BEAVER PONDS PG
12385
Whetstone Mtn
Squaw Gulch
Carbon Pk 12079
Pass Creek
4WD
Kubler Mine
R.87W.
R.86W.
T. 14 S.
135
780
826
N
LILLY LAKE - FLORESTA TRACT
R.4W.
R.3W.
BM 7923
OREGON 10029
Oregon Gul
SOAP CREEK CG
BM 7740
Pearson Pk 9300
Harris Park
East Coal
Fen Gul
Elk
Lion Gul
LION 10052
Elk Park
Willow
East
Gul
Main
BM 9629
BM 7931
Chance Cr
Mill Gulch
Gulch
West Mesa
RUNAWAY 9570
Bull Bear Gul
West Fork
East Fork
Red Creek
Tenderfoot Hill
Dry Gulch
Elk Creek
West Fork
East Fork Dry Creek
Willow Creek
BM 7912
BM 8291
9538 SAPINERO
SAPINERO
Cottonwood
Dillon Gul
BLUE MESA
ELK CREEK CG
Rec Area Headquarters
CURECANTI NATIONAL RECREATION AREA
Sapinero
LAKE FORK CG
BM 7718
T. 49 N.
0 1 2 3 4 miles
SOAP MESA TRACT

Figure: F-2 LANDS NEAR KEBLER PASS AND BLUE MESA RESERVOIR IN GUNNISON COUNTY WHICH AMAX PROPOSES TO OFFER TO THE FOREST SERVICE. ▨


Upper Peeler Lakes
Oh-Be-Joyful Wilderness Study Area
Elk Basin
Gunsight Pass
TV Tower
Mount Emmons
Red Lady Basin
Wolverine
Daisy Mine
Coon Basin
Spring
Evans Basin
Tailings Ponds
Coal Creek
River
Peanut Mine
Peanut Lake
Slate River
GUNNISON NATIONAL FOREST
NATIONAL BOUNDARY
Crested Butte
Cem
Wildcat Creek
Ridge
29
28
27
26
30
31
32
33
34
35
3
4
8
9
10
11
2

LEGEND

🟥 AMAX proposed construction

▨ Subsidence limits (Maximum, 45°)

🟨 Private land inside the National Forest

● Iron Bog

▲ Crested Butte Municipal water intake

— Boundary of AMAX selected land

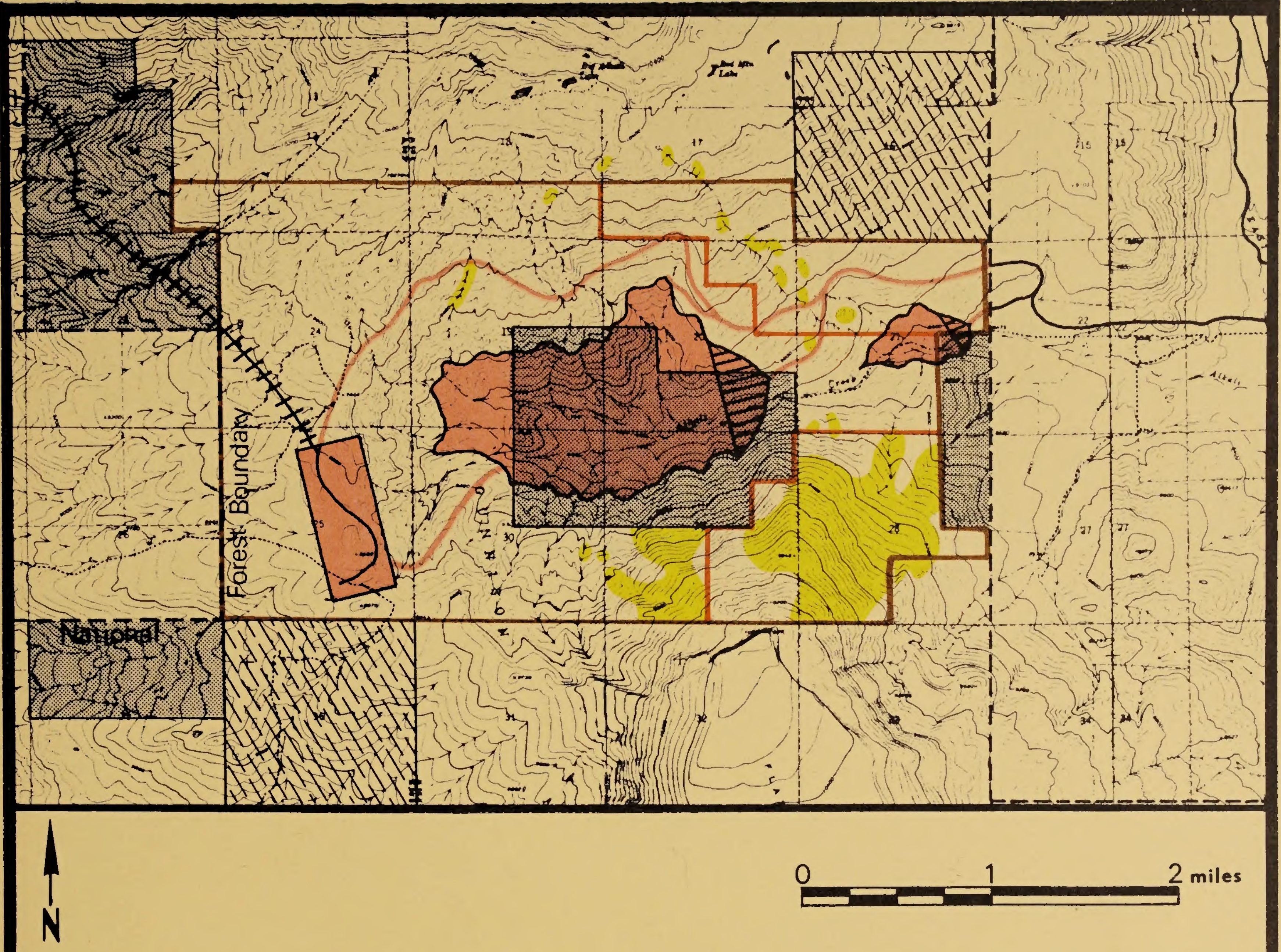
— Alternative boundaries for the selected land

Mt. Emmons Mining Project

COAL CREEK MINE SITE
EXCHANGE ALTERNATIVES

July 1981

FIG. F-3


National
Forest Boundary
Alkali
Creek
N
0
1
2 miles

LEGEND

- 🟥 AMAX proposed construction
- ▩ Private land inside the National Forest
- ▨ State land
- 🟨 Sensitive big game cover
- ━ Boundary of AMAX selected land
- ━ Alternative boundary for the selected land

Mt. Emmons Mining Project

ALKALI MILL SITE
EXCHANGE ALTERNATIVES

July 1981

FIG. F-4

Appendix G. Project Schedule

APPENDIX G: PROJECT SCHEDULE

The generic schedule listed below is adapted from the schedule AMAX described in its original Plan of Operations (AMAX, 1979a). In that schedule, Year 1 was 1980, whereas currently Year 1 is about 1984.

Year 1	Survey for sites, roads, and haulage alignment.
Year 2	Begin mine access roads and mine site preparation. Begin mine access drifts and mine ventilation drifts. Begin reconstruction of the Carbon Creek road to the south portal of the Mt. Axtell tunnel.
Year 3	Begin mine surface buildings. Begin mill access road.
Year 4	Begin mill site preparation. Begin Mt. Axtell tunnel. Begin railroad construction. Begin transmission line access work.
Year 5	Begin Mt. Emmons ore haulage drift. Begin construction of mill buildings. Begin construction of tailing dam.
Year 6	Complete Mt. Axtell tunnel. Complete mine ventilation system. Complete mine surface facilities. Begin East River pumphouse and pipeline. Begin Salida railhead facility. Begin transmission line construction.
Year 7	Complete ore haulage system. Complete tailing dam.
Year 8	Complete mine development. Complete mill buildings. Begin test production. Complete transmission line construction.
Year 9	Begin full production.

Appendix H. Reference Guide for Issue Analysis

APPENDIX H: REFERENCE GUIDE FOR ISSUE ANALYSIS

Twenty-six issues were identified during the scoping process (1979b). The analysis of most of these issues can be found throughout the text of this draft EIS. The following reference guide is included to ease the search for issue-related discussions.

Issue 1. WHAT WILL BE THE IMPACTS ON THE QUALITY OF LOCAL AIR AND WATER?

See the following entries in the Index: Air, Air Quality-Related Values, Groundwater, Coal Creek Watershed, Water, Water Supply.

Issue 2. WHERE SHOULD THE PROPOSED MILL/TAILINGS SITE BE LOCATED?

See Mill Site in the Index.

Issue 3. HOW WILL DISTURBED AREAS BE RECLAIMED?

See Reclamation in the Index.

Issue 4. WHAT WILL BE THE IMPACTS OF USING LOCAL SOURCE MATERIALS (COAL, GRAVEL, ETC.) IN THE PROPOSED PROJECT?

See Coal, and Sand and Gravel in the Index.

Issue 5. WHAT METHODS AND ROUTES SHOULD BE USED FOR TRANSPORTING PERSONNEL AND SUPPORT SERVICES TO THE PROPOSED PROJECT'S WORK SITES?

See Worker Access in the Index.

Issue 6. WHAT IMPACT WILL THE PROPOSED PROJECT HAVE ON NATIVE ANIMALS AND PLANTS, THEIR PROCESSES, ATTRIBUTES AND SPECIFIC ENVIRONMENTS (WITH EMPHASIS ON THOSE IDENTIFIED VIA PUBLIC INPUT AND SCOPING)?

See the following entries in the Index: Aquatic Ecology, Elk and Deer, Iron Bog, Grazing, Sage Grouse, Sundew Plant, Timber, Vegetation, Wetlands, and Wildlife.

Issue 7. WHAT IMPACT WILL PROPOSED PROJECT ACTIVITIES AND THE GENERATED POPULATION INCREASE HAVE ON LOCAL RECREATIONAL USES?

See Outdoor Recreation and Urban Recreation in the Index.

Issue 8. WHAT IMPACT WILL CHANGES IN RECREATION ACTIVITIES HAVE ON OTHER RESOURCES AND USES OF THE AREA?

See Outdoor Recreation in the Index.

Issue 9. HOW WILL THE WEST ELK WILDERNESS BE IMPACTED BY THE PROPOSED PROJECT?

See Air Quality-Related Values, Outdoor Recreation, and Wilderness in the Index.

Issue 10. WHAT WOULD BE THE IMPACTS OF A MINING OPERATION SCALED DOWN SO AS TO REQUIRE FEWER EMPLOYEES AND OPERATE OVER A LONGER PERIOD OF TIME?

See Small Mine in the Index.

Issue 11. WHAT WILL BE THE IMPACTS ON EXISTING INDUSTRIES AND RELATED BUSINESSES RESULTING FROM THE PROPOSED INTRODUCTION OF THE MINE?

See Growth Impacts, Mine Closure, and Socioeconomics in the Index.

Issue 12. WHAT IMPACT WILL PROJECT-INDUCED POPULATION CHANGES HAVE ON HOUSING IN GUNNISON COUNTY?

See Housing in the Index.

Issue 13. WHAT IMPACT WILL THE PROPOSED PROJECT HAVE ON THE DEMAND FOR PUBLIC SERVICES IN LOCAL AREAS?

See Public Services in the Index.

Issue 14. WHAT WILL HAPPEN TO THE HISTORIC CHARACTER OF THE CRESTED BUTTE HISTORIC DISTRICT AS A RESULT OF THE PROPOSED PROJECT?

See Crested Butte Historic District in the Index.

Issue 15. WHAT IMPACT WILL THE PROJECT-INDUCED POPULATION CHANGE HAVE ON THE EXISTING SOCIAL STRUCTURE OF THE GUNNISON COUNTY AREA?

See Social Structure in the Index.

Issue 16. WHAT ARE THE IMPACTS OF THE TOTAL ENERGY REQUIREMENT OF THE PROPOSED PROJECT, AND WHAT CONSERVATION MEASURES WILL BE APPLIED TO LIMIT THOSE REQUIREMENTS?

See Energy in the Index.

Issue 17. WHAT WILL HAPPEN TO THE 'QUALITY OF LIFE' IN GUNNISON COUNTY IF THE PROPOSED PROJECT IS IMPLEMENTED?

See Quality of Life in the Index.

Issue 18. DOES THE NEED FOR MOLYBDENUM JUSTIFY THE PROJECT?

See Mining Law and Uses of Molybdenum in the Index.

Issue 19. HOW WILL ANY LAND EXCHANGES ASSOCIATED WITH THE PROPOSED PROJECT BE IN THE PUBLIC INTEREST?

See Land Classification and Land Exchange in the Index.

Issue 20. HOW MUCH TIME SHOULD BE ALLOCATED TO THE PREPARATION OF THE EIS?

See Project History in the Index for an indication of how much time it took.

Issue 21. SHOULD A REGIONAL EIS BE WRITTEN?

The suggestion that a regional EIS be written was declined. See Forest Service (1979b, pp. 17-18)

Issue 22. HOW CAN PEOPLE AND INSTITUTIONS INVOLVED IN THE PROJECT GUARANTEE A QUALITY JOB?

This is a process-oriented question, and its answer lies in the realm of work performance rather than through EIS analysis.

Issue 23. WILL THE 'NO ACTION' ALTERNATIVE BE GIVEN EQUAL CONSIDERATION WITH ALL OTHER ALTERNATIVES?

See 'No Action' Alternative in the Index.

Issue 24. SHOULD THE 1872 MINING LAW BE CHANGED SO THAT IT MORE ACCURATELY REFLECTS TODAY'S VALUES?

An issue raised during the scoping process questioned the applicability of the 1872 Mining law to modern mining and suggested that perhaps it should be revised. The Forest Service implements the 1872 Mining Law through its regulations in 36 CFR 228 (previously 36 CFR 252), which were promulgated in 1974. As this is a project EIS and not one devoted to regulatory revision, the issue was not analyzed in detail.

Issue 25. CAN THE ORE HAULAGE SYSTEM BE DESIGNED AND UTILIZED TO SERVE OTHER TRANSPORTATION NEEDS IN GUNNISON COUNTY?

See 'Mass Transit' on page 39.

Issue 26. HOW SHOULD DELIVERY OF ELECTRICAL POWER TO THE MINE AND MILL SITES BE ACCOMPLISHED?

See Power Supply in the Index.

Appendix I. Methodology

APPENDIX I: METHODOLOGY

This Appendix identifies methodologies underlying the discussions and analyses in this draft EIS.

VEGETATION

Vegetation methodologies are described in Stoecker and Keamerer (1980) and CDM (1980w and f).

WILDLIFE

Wildlife Impact Indices - One of the issues surfaced during scoping for the Mt. Emmons mining and milling Project EIS asked that, in a broad context, impacts on all wildlife should be considered. The method discribed here was developed to respond to the public issue.

The following assumptions were used in developing the impact index methodology:

(1) All habitat has inherent value to wildlife and impacts that change the relative quantities of habitat can be measured and compared.

(2) Available data bases should be adequate to evaluate wildlife impacts. No special study is necessary.

(3) The habitat capability coefficients which are in Forest Service computer data files at Fort Collins (Wildlife Habitat Relationships Data Base) represent the importance of a given habitat type to each species for breeding, feeding, and resting.

(4) For the index development all species are given equal value.

(5) Habitats which are in short supply have more value than proportionately abundant habitats.

(6) A worst case analysis will be used which assumes that all disturbed areas will be unavailable to wildlife for 30 to 50 years. Upon reclamation acceptance, the habitats will again be available to wildlife.

The steps used to develop an index of wildlife impact are listed below. It should be emphasized that this index will only be one measure of wildlife impact. Separate analyses discuss effects on species highlighted in public issues (elk and sagegrouse) and threatened or endangered species.

(1) Project area species lists (Stoecker and Keammerer, 1980) were used to request a computer printout of wildlife habitat relationships (Tables I-3 and I-4). It is recognized that this is not an all inclusive list but it is large enough to include species representing nearly all combinations of wildlife habitat relationships and omissions are considered random and without bias.

(2) Using habitat capability coefficients (HCC) from the wildlife habitat relationships lists, species influence factors (SIF) were calculated for each habitat. See Table I-1.

(3) Finally, an impact index value was calculated by summing the products of the number of species and the species influence factor. The total was divided by 100 to obtain an index value which, when multiplied by the number

of impacted acres, was in the order of magnitude of the acres affected. See Table I-1. The final results are summarized in Table I-2.

The index values developed for this analysis have the following properties:

(a) They focus on species as the primary unit of measure.
(b) They are not influenced by animal size, economic return to humans or emotional biases.
(c) They recognize added importance of relatively scarce habitats.
(d) They are area specific in relation to the species used and the local habitat composition.
(e) They consider habitat value across all species, not a few select species groups.

Other Wildlife Methodologies - Other wildlife methodologies are described in Stoecker and Keammerer (1980) CDM (1980e and f) and quarterly reports of Colorado Cooperative Wildlife Research Unit (3/79 to 3/81).

AQUATIC ECOLOGY

Aquatic ecology methodology is described in CDM (1980w).

ENERGY

Energy methodology used standard calculations based on information contained in AMAX (1981a), Forest Service (1981b) and CERI (1980).

WATER

Surface and groundwater monitoring methodologies are described in CDM (1980a, v) and Woodward-Clyde (1980a). Impact prediction methodologies are described in Snow (1980), Williams (1980a-c), and Woodward-Clyde (1980b).

AIR

Meteorology and air quality monitoring methodologies are described in CDM (1980p, q, s, t). Air quality impact methodology is described in CDM (1980a, r; 1981a).

NOISE

The methodology used for monotoring ambient noise levels is described in SAI (1980a, b). The methodology used for predicting noise impacts described in Mirabelli (1980).

CULTURAL RESOURCES

The methodology used to survey and analyze cultural resource impacts is described in: Lennon, et. al., (1980), Glover, et. al., (1981), CDM, (1980g), Forest Service, (1981c), Baker, (1980)

VISUAL RESOURCES

The methodology for determining existing visual resources is described in CDM (1980f) and Forest Service (1974). The methodology for assessing visual resource impacts is described in Forest Service (1974).

OUTDOOR RECREATION

The methodology for determining current outdoor recreation uses is described in Forest Service (1980c, 1981a). Impact assessment methodologies are described in these same references.

TRANSPORTATION

Methodology used to analyse transportation impacts is described in BMML (1981b).

SOCIOECONOMICS

Methodologies for describing current socioeconomic conditions, and for determining impacts on them, are discussed in BMML (1980a, b; 1981a-d).

Cost figures were generally converted into 1980 dollars using cost-of-living data from the Bureau of Economic Analysis (1981).

GEOLOGY

Standard field and laboratory techniques were used in mapping geologic units.

SOILS

Standard field and laboratory techniques were used in mapping soil units.

AVALANCHE

Avalanche prediction methodologies are described in Mears (1980).

TABLE I-1 WILDLIFE IMPACT INDEX CALCULATIONS SAGEBRUSH HABITAT (36.03%)*

HCC	# Species ***	SIF**	# SP X SIF
1.00	16	2.44	39.04
.83	6	2.36	14.16
.66	10	2.26	22.60
.50	11	2.14	23.54
.40	3	2.04	6.12
.33	10	1.96	19.60
.30	4	1.92	7.68
.23	1	1.80	1.80
.20	2	1.74	3.48
.16	4	1.65	6.60
.13	2	1.56	3.12
.06	1	1.22	1.22
			149.96

Impact Index Value 149.96/100 = 1.49

* Proportion of the study area supporting this habitat type. See Table 3-1.

** Species Influence Factor = Log $\frac{\text{(HCC/Max HCC) X 100}}{\text{P}}$

where P = Proportion of the study area with subject habitat (as a decimal), and

Max/HCC = Haximum Habitat Capability Coefficient possible (9 for Aspen, Lodgepole pine and spruce-fir habitats and 1.0 for other habitats in this analysis)

*** Number of species using this habitat and for which biologists have assigned a habitat capability coefficient as tabled above.

TABLE I-2 MOUNT EMMONS PROJECT AREA WILDLIFE HABITAT VALUE INDEXES

Habitat	Index Value
Rockland/Talus	0.93
Sagebrush	1.49
Alpine	1.51
Dry Mtn. Meadow	1.67
Wet Mtn. Meadow	1.70
Spruce-fir Woodland	1.78
Aspen Woodland	2.11
Lodgepole Pine	2.67
Riparian	3.61

Table I-3

WILDLIFE HABITAT RELATIONSHIPS ANALYSIS
SPECIES LIST FOR THE MOUNT EMMONS PROJECT
BY SPECIAL NEEDS CAPABILITY

SPEC CODE	COMMON NAME	ALPINE HABITAT CAPABILITY	SAGEBRUSH SHRUBLAND CAPABILITY	WET MTN MEADOW CAPABILITY	DRY MTN MEADOW CAPABILITY	RIPARIAN HABITAT CAPABILITY
A025	TIGER SALAMANDER					1.00
B001	AMERICAN AVOCET	0.00	0.00	0.00	0.00	1.00
B004	BREWER'S BLACKBIRD	0.00	1.00	0.00	0.00	.66
B005	RED-WINGED BLACKBIRD	0.00	0.00	0.00	0.00	1.00
B009	MOUNTAIN BLUEBIRD	.66	.66	.66	.66	.40
B014	LARK BUNTING	0.00	.50	0.00	0.00	0.00
B024	BLACK-CAPPED CHICKADEE	0.00		0.00	0.00	1.00
B025	MOUNTAIN CHICKADEE	0.00	0.00	0.00	0.00	.50
B028	BROWN-HEADED COWBIRD	0.00	0.00	0.00	0.00	.66
B030	SANDHILL CRANE (LITTLE BROWN CRANE)	0.00		.40		1.00
B032	BROWN CREEPER	0.00	.66	0.00	0.00	0.00
B035	RED CROSSBILL	0.00	0.00	0.00	0.00	.66
B037	COMMON CROW	0.00	0.00	0.00	0.00	1.00
B041	DIPPER	0.00		0.00	0.00	1.00
B042	MOURNING DOVE	0.00	.83	0.00	.46	0.00
B047	GADWALL	0.00		0.00	0.00	1.00
B054	PINTAIL DUCK	0.00		0.00	0.00	0.00
B059	BALD EAGLE	0.00	.23	0.00	0.00	1.00
B060	GOLDEN EAGLE	.23	.83	1.00	1.00	.50
B065	PRAIRIE FALCON	.66	1.00	.66	.83	.50
B068	CASSIN'S FINCH	0.00	0.00	.33	.33	.33
B069	GRAY-CROWNED ROSY-FINCH	1.00	0.00	.33	.33	0.00
B070	HOUSE FINCH	0.00	.40	0.00	0.00	0.00
B072	COMMON FLICKER	0.00	.16	.33	.33	1.00
B076	DUSKY FLYCATCHER	0.00	.50	0.00	0.00	.83
B081	OLIVE-SIDED FLYCATCHER	0.00	0.00	0.00	.33	.33
B084	WESTERN FLYCATCHER	0.00	0.00	1.00	0.00	1.00
B085	WILLOW FLYCATCHER	0.00	0.00	1.00	1.00	1.00
B090	AMERICAN GOLDFINCH	0.00	.30	0.00	0.00	.20
B099	GOSHAWK	.06	.16	.33	.33	.83
B107	BLUE GROUSE	.16	.40	0.00	.83	0.00
B109	SAGE GROUSE	0.00	1.00	.13	.13	0.00
B112	BLACK-HEADED GROSBEAK	0.00	.50	0.00	0.00	1.00
B115	PINE GROSBEAK	0.00	0.00	0.00	0.00	0.00
B127	COOPER'S HAWK	0.00	.33	.56	.56	1.00
B130	MARSH HAWK	.13	.66	.33	.33	1.00
B133	RED-TAILED HAWK	.33	.33	.33	.33	.50
B134	ROUGH-LEGGED HAWK	0.00	.66	0.00	0.00	.33
B135	SHARP-SHINNED HAWK	.06	.16	.16	.16	1.00
B136	SWAINSON'S HAWK	.50	.66	.83	.83	1.00
B137	BLACK-CROWNED NIGHT-HERON	0.00	.50	.66	0.00	1.00
B138	GREAT BLUE HERON	0.00	.50	0.00	0.00	1.00
B144	BROAD-TAILED HUMMINGBIRD	0.00	.30	0.00	.46	1.00
B145	CALLIOPE HUMMINGBIRD	.13	0.00	.50	.50	1.00
B147	RUFOUS HUMMINGBIRD	.13	0.00	.50	.50	.66
B150	GRAY JAY	.13	0.00	.06	.06	.40
B153	STELLER'S JAY	0.00	0.00	0.00	.16	0.00
B156	BELTED KINGFISHER	0.00		0.00	0.00	1.00
B157	KILLDEER	0.00		1.00	1.00	.83
B160	WESTERN KINGBIRD	0.00	.40	0.00	.83	1.00
B161	GOLDEN-CROWNED KINGLET	0.00	0.00	0.00	0.00	.66
B162	RUBY-CROWNED KINGLET	0.00	0.00	0.00	0.00	1.00
B166	AMERICAN KESTREL	.06	0.00	.46	.46	.46
B168	HORNED LARK	.66	.50	.20	.50	0.00
B175	BLACK-BILLED MAGPIE	0.00	.83	0.00	0.00	1.00
B176	MALLARD	0.00		1.00		0.00
B179	WESTERN MEADOWLARK	0.00	.50	0.00	.50	0.00
B180	MOCKINGBIRD	0.00	1.00	0.00	0.00	1.00
B181	COMMON MERGANSER	0.00		0.00	0.00	1.00
B186	RED-BREASTED NUTHATCH	0.00	.13	.06	0.00	0.00
B187	WHITE-BREASTED NUTHATCH	0.00	0.00	0.00	0.00	0.00
B188	CLARK'S NUTCRACKER	0.00	.06	0.00	0.00	0.00
B199	GREAT HORNED OWL	0.00	.83	.33	.33	.66
B205	SHORT-EARED OWL	0.00		0.00	0.00	1.00
B214	WILSON'S PHALAROPE (GRUNTER)	.30	.20	1.00	0.00	0.00
B218	WATER PIPIT		0.00	0.00	0.00	1.00
B229	WHITE-TAILED PTARMIGAN	1.00	0.00	.33	.33	.66
B239	COMMON RAVEN	1.00	.33	.16	.16	0.00
B244	AMERICAN ROBIN	.50	.50	0.00	.50	0.00
B252	SOLITARY SANDPIPER	0.00	0.00	.33	0.00	0.00
B253	SPOTTED SANDPIPER	1.00	0.00	1.00		.20
B258	WILLIAMSON'S SAPSUCKER	0.00	0.00	0.00	0.00	0.00
B259	YELLOW-BELLIED SAPSUCKER	0.00	0.00	0.00	0.00	0.00
B264	LOGGERHEAD SHRIKE	0.00	1.00	.13	.13	1.00
B266	PINE SISKIN	0.00	0.00	0.00	0.00	0.00
B267	COMMON SNIPE	0.00	0.00	1.00		1.00
B268	TOWNSEND'S SOLITAIRE	.66	.66	0.00	0.00	0.00
B271	BREWER'S SPARROW	0.00	1.00	0.00	0.00	.33
B273	CHIPPING SPARROW	.33	.33	.33	.13	0.00
B281	HOUSE SPARROW	0.00	0.00	0.00	0.00	.20
B284	LINCOLN'S SPARROW	0.00	.13	1.00	0.00	1.00
B286	SAGE SPARROW	0.00	1.00	0.00	0.00	0.00
B287	SAVANNAH SPARROW	0.00	.66	.56	.56	0.00
B289	SONG SPARROW	0.00	.83	1.00	.50	1.00
B292	VESPER SPARROW	0.00	1.00	.50	1.00	.66
B293	WHITE-CROWNED SPARROW	.73	.66	1.00	0.00	1.00
B296	STARLING	0.00	.50	0.00	0.00	.50
B301	WHITE-THROATED SWIFT	0.00	0.00	0.00	.33	0.00
B303	BARN SWALLOW	0.00	.66	.83	.66	1.00
B304	CLIFF SWALLOW	0.00	.66	.83	.66	1.00
B306	TREE SWALLOW	0.00	.33	.50	0.00	1.00
B307	VIOLET-GREEN SWALLOW	.33	.16	.33	.16	.33
B310	WESTERN TANAGER	0.00	.33	0.00	0.00	.50
B311	BLUE-WINGED TEAL	0.00		0.00	0.00	0.00

Table I-3
(continued)

WILDLIFE HABITAT RELATIONSHIPS ANALYSIS
SPECIES LIST FOR THE MOUNT EMMONS PROJECT
BY SPECIAL NEEDS CAPABILITY

SPEC CODE	COMMON NAME	ALPINE HABITAT CAPABILITY	SAGEBRUSH SHRUBLAND CAPABILITY	WET MTN MEADOW CAPABILITY	DRY MTN MEADOW CAPABILITY	RIPARIAN HABITAT CAPABILITY
B313	GREEN-WINGED TEAL	0.00		0.00	0.00	0.00
B320	HERMIT THRUSH	0.00	0.00	.06	.06	.06
B323	SWAINSON'S THRUSH	0.00	.33	.06	.06	1.00
B329	GREEN-TAILED TOWHEE	0.00	1.00	.33	.13	1.00
B330	RUFOUS-SIDED TOWHEE	0.00	1.00	0.00	0.00	1.00
B333	SAGE THRASHER	0.00	1.00	0.00	0.00	.83
B336	VEERY	0.00	0.00	0.00	0.00	1.00
B342	SOLITARY VIREO	0.00		0.00	0.00	1.00
B343	WARBLING VIREO	0.00		0.00	0.00	1.00
B350	DOWNY WOODPECKER	0.00	.30	0.00	0.00	.66
B351	HAIRY WOODPECKER	0.00	.16	0.00	0.00	0.00
B357	RED-HEADED WOODPECKER	0.00		0.00	0.00	1.00
B381	MACGILLIVRAY'S WARBLER	.66		.33	0.00	1.00
B386	ORANGE-CROWNED WARBLER	0.00	.33	.66	.66	1.00
B394	WILSON'S WARBLER	1.00		1.00	0.00	1.00
B396	YELLOW WARBLER	0.00	0.00	1.00	0.00	1.00
B397	YELLOW-RUMPED WARBLER	0.00	.33	.33	.33	1.00
B403	HOUSE WREN	.83	0.00	0.00	0.00	1.00
B405	ROCK WREN	0.00	.50	0.00	0.00	0.00
M013	BLACK BEAR	.20	.20	.46	.46	1.00
M015	BEAVER	.16	0.00	.16	0.00	1.00
M016	MOUNTAIN BIGHORN	1.00	.30	0.00	.66	0.00
M017	BOBCAT	.20	1.00	.40	.40	.50
M021	LEAST CHIPMUNK	.20	1.00	0.00	0.00	0.00
M026	COYOTE	.50	1.00	1.00	1.00	1.00
M029	NUTTALL'S COTTONTAIL	0.00	1.00	0.00	0.00	1.00
M030	MULE DEER	.33	1.00	.46	.46	1.00
M032	COMMON ELK	.50	.83	.56	.56	1.00
M033	ERMINE (SHORTTAIL WEASEL)	.50	0.00	.30	.20	.66
M038	RED FOX	.20	.50	.30	.30	1.00
M042	NORTHERN POCKET GOPHER	1.00	.66	0.00	1.00	0.00
M045	SNOWSHOE HARE	0.00	0.00	0.00	0.00	1.00
M047	WHITE-TAILED JACK RABBIT	.50	1.00	0.00	0.00	.20
M050	PINE MARTEN	.16	0.00	0.00	.33	0.00
M058	DEER MOUSE	.20	1.00	0.00	.50	.50
M072	WESTERN JUMPING MOUSE		0.00	1.00	0.00	1.00
M075	YELLOW-BELLIED MARMOT	1.00	0.00	.66	1.00	0.00
M076	MUSKRAT	0.00			0.00	1.00
M089	GUNNISON'S PRAIRIE DOG	0.00	0.00	0.00	1.00	0.00
M091	ROCKY MOUNTAIN PIKA	1.00	0.00	.66	1.00	0.00
M094	PORCUPINE	0.00	0.00	.16	0.00	.50
M096	RACCOON	0.00	0.00	0.00	0.00	1.00
M105	MASKED SHREW	0.00		1.00	0.00	.83
M107	NORTHERN WATER SHREW	0.00	0.00	.83	0.00	1.00
M111	STRIPED SKUNK	0.00	.50	0.00	0.00	1.00
M117	GOLDEN-MANTLED GROUND SQUIRREL	.50	0.00	0.00	.50	0.00
M119	RED SQUIRREL	0.00	0.00	0.00	0.00	0.00
M128	LONG-TAILED VOLE	1.00	.50	1.00	1.00	1.00
M129	MEADOW VOLE	0.00		1.00	.50	1.00
M131	MOUNTAIN VOLE	1.00		1.00	1.00	1.00
M144	LONG-TAILED WEASEL	.50	.50	.20	1.00	.50
R063	WESTERN TERRESTRIAL GARTERSNAKE	0.00		1.00	0.00	1.00

Table I-4

WILDLIFE HABITAT RELATIONSHIPS ANALYSIS
SPECIES LIST FOR THE MOUNT EMMONS PROJECT
BY VEGETATION TYPE HABITAT CAPABILITY COEFFICIENT

SPEC CODE	COMMON NAME	ASPEN CAPABILITY	LODGEPOLE PINE CAPABILITY	SPRUCE FIR CAPABILITY	DOUGLAS FIR CAPABILITY
A025	TIGER SALAMANDER				
B001	AMERICAN AVOCET	0.00	0.00	0.00	0.00
B004	BREWER'S BLACKBIRD	0.00	0.00	0.00	0.00
B005	RED-WINGED BLACKBIRD	0.00	0.00	0.00	0.00
B009	MOUNTAIN BLUEBIRD	5.96	4.97	4.82	5.63
B014	LARK BUNTING	0.00	0.00	0.00	0.00
B024	BLACK-CAPPED CHICKADEE	4.95	2.22	2.22	2.22
B025	MOUNTAIN CHICKADEE	6.06	1.91	5.62	5.82
B028	BROWN-HEADED COWBIRD		0.00	0.00	0.00
B030	SANDHILL CRANE (LITTLE BROWN CRANE)		0.00	0.00	0.00
B032	BROWN CREEPER	1.04	6.44	5.77	6.04
B035	RED CROSSBILL	0.00	6.98	7.32	7.15
B037	COMMON CROW	3.00	0.00	.53	.40
B041	DIPPER				
B042	MOURNING DOVE	0.00	1.35	0.00	0.00
B047	GADWALL	0.00	0.00	0.00	0.00
B054	PINTAIL DUCK	0.00	0.00	0.00	0.00
B059	BALD EAGLE	0.00			
B060	GOLDEN EAGLE	3.52	3.31	4.18	3.64
B065	PRAIRIE FALCON	3.26	6.86	4.22	5.95
B068	CASSIN'S FINCH	.95	3.63	2.21	.84
B069	GRAY-CROWNED ROSY-FINCH	0.00	.50	.50	.33
B070	HOUSE FINCH	0.00	5.02	0.00	0.00
B072	COMMON FLICKER	5.82	1.72	2.74	2.91
B076	DUSKY FLYCATCHER	4.30	2.88	1.20	1.20
B081	OLIVE-SIDED FLYCATCHER	3.00	1.64	5.64	0.00
B084	WESTERN FLYCATCHER	5.16	3.86	3.86	1.40
B085	WILLOW FLYCATCHER	4.00	0.00	0.00	1.32
B090	AMERICAN GOLDFINCH	0.00	0.00	0.00	2.22
B099	GOSHAWK	6.11	4.87	2.57	3.93
B107	BLUE GROUSE	5.98	4.29	5.32	3.90
B109	SAGE GROUSE	0.00	0.00	0.00	0.00
B112	BLACK-HEADED GROSBEAK	0.00	0.00	0.00	3.28
B115	PINE GROSBEAK	0.00	2.66	3.00	1.20
B127	COOPER'S HAWK	5.32	6.98	0.00	6.98
B130	MARSH HAWK	0.00	0.00	0.00	0.00
B133	RED-TAILED HAWK	1.97	5.11	1.97	3.99
B134	ROUGH-LEGGED HAWK	0.00	0.00	0.00	0.00
B135	SHARP-SHINNED HAWK	4.71	6.54	5.66	6.98
B136	SWAINSON'S HAWK	6.47	4.48	0.00	3.26
B137	BLACK-CROWNED NIGHT-HERON				
B138	GREAT BLUE HERON	0.00	0.00	0.00	
B144	BROAD-TAILED HUMMINGBIRD	5.74	5.84	5.84	5.84
B145	CALLIOPE HUMMINGBIRD	2.07	5.10	5.10	5.10
B147	RUFOUS HUMMINGBIRD	1.58	3.11	3.11	3.11
B150	GRAY JAY	.52	3.33	6.82	3.63
B153	STELLER'S JAY	1.08	3.02	2.92	3.03
B156	BELTED KINGFISHER	0.00	0.00	0.00	0.00
B157	KILLDEER				
B160	WESTERN KINGBIRD	5.17	0.00	0.00	5.33
B161	GOLDEN-CROWNED KINGLET	3.76	4.61	5.97	6.13
B162	RUBY-CROWNED KINGLET	2.14	5.55	5.71	4.02
B166	AMERICAN KESTREL	1.78	.68	.24	1.03
B168	HORNED LARK	0.00	0.00	0.00	0.00
B175	BLACK-BILLED MAGPIE	0.00	.18	.18	.18
B176	MALLARD				
B179	WESTERN MEADOWLARK	.40	.40	.40	.40
B180	MOCKINGBIRD	0.00	0.00	0.00	0.00
B181	COMMON MERGANSER	0.00			
B186	RED-BREASTED NUTHATCH	1.00	.52	1.30	2.50
B187	WHITE-BREASTED NUTHATCH	.52	.60	1.30	1.60
B188	CLARK'S NUTCRACKER	.91	6.47	6.98	5.80
B199	GREAT HORNED OWL	4.60	5.79	5.13	5.96
B205	SHORT-EARED OWL	0.00	0.00	0.00	0.00
B214	WILSON'S PHALAROPE (GRUNTER)	0.00	0.00	0.00	0.00
B218	WATER PIPIT	0.00	0.00	0.00	0.00
B229	WHITE-TAILED PTARMIGAN	0.00	0.00	2.31	0.00
B239	COMMON RAVEN	2.21	2.58	2.58	2.58
B244	AMERICAN ROBIN	7.44	6.60	5.26	6.59
B252	SOLITARY SANDPIPER			0.00	
B253	SPOTTED SANDPIPER				
B258	WILLIAMSON'S SAPSUCKER	3.32	4.49	1.45	0.00
B259	YELLOW-BELLIED SAPSUCKER	3.71	1.49	1.19	0.00
B264	LOGGERHEAD SHRIKE	0.00	0.00	0.00	0.00
B266	PINE SISKIN	1.48	1.76	2.00	4.16
B267	COMMON SNIPE	0.00	0.00	0.00	0.00
B268	TOWNSEND'S SOLITAIRE	3.92	4.34	6.08	6.54
B271	BREWER'S SPARROW	0.00	0.00	0.00	0.00
B273	CHIPPING SPARROW	3.66	3.66	0.00	3.49
B281	HOUSE SPARROW	0.00	0.00	0.00	3.03
B284	LINCOLN'S SPARROW	5.36	4.53	4.53	4.53
B286	SAGE SPARROW	0.00	0.00	0.00	0.00
B287	SAVANNAH SPARROW	1.32	0.00	0.00	1.32
B289	SONG SPARROW	3.73	2.76	2.92	3.02
B292	VESPER SPARROW	1.83	1.83	1.16	2.49
B293	WHITE-CROWNED SPARROW	4.12	1.90	3.52	2.76
B296	STARLING	4.44	0.00	0.00	0.00
B301	WHITE-THROATED SWIFT	3.90	3.30	3.90	0.00
B303	BARN SWALLOW	0.00	0.00	0.00	0.00
B304	CLIFF SWALLOW	1.32	0.00	0.00	0.00
B306	TREE SWALLOW	5.21	2.19	2.09	3.19
B307	VIOLET-GREEN SWALLOW	3.89	3.57	3.57	3.57
B310	WESTERN TANAGER	3.74	5.38	3.41	5.54
B311	BLUE-WINGED TEAL	0.00	0.00	0.00	0.00

Table I-4
(continued)

WILDLIFE HABITAT RELATIONSHIPS ANALYSIS
SPECIES LIST FOR THE MOUNT EMMONS PROJECT
BY VEGETATION TYPE HABITAT CAPABILITY COEFFICIENT

SPEC CODE	COMMON NAME	ASPEN CAPABILITY	LODGEPOLE PINE CAPABILITY	SPRUCE FIR CAPABILITY	DOUGLAS FIR CAPABILITY
B313	GREEN-WINGED TEAL				
B320	HERMIT THRUSH	6.03	4.32	6.03	5.18
B323	SWAINSON'S THRUSH	2.78	1.75	1.85	2.60
B329	GREEN-TAILED TOWHEE	0.00	0.00	0.00	2.70
B330	RUFOUS-SIDED TOWHEE	1.10	.58	0.00	1.73
B333	SAGE THRASHER	0.00	0.00	0.00	0.00
B336	VEERY	0.00		0.00	
B342	SOLITARY VIREO	5.00	0.00	0.00	5.00
B343	WARBLING VIREO	6.66	1.70	1.70	1.70
B350	DOWNY WOODPECKER	6.20	5.77	3.31	5.51
B351	HAIRY WOODPECKER	4.81	6.03	5.39	6.30
B357	RED-HEADED WOODPECKER	0.00	0.00	0.00	5.69
B381	MACGILLIVRAY'S WARBLER	5.63	0.00	0.00	4.16
B386	ORANGE-CROWNED WARBLER	6.00	0.00	0.00	3.30
B394	WILSON'S WARBLER	4.60	.85	0.00	0.00
B396	YELLOW WARBLER	7.20	.76	1.04	.76
B397	YELLOW-RUMPED WARBLER	3.23	5.54	5.30	5.10
B403	HOUSE WREN	4.32	1.45	2.79	2.86
B405	ROCK WREN	.60	1.00	.80	2.32
M013	BLACK BEAR	7.50	3.34	5.72	6.80
M015	BEAVER				
M016	MOUNTAIN BIGHORN	1.84	2.86	2.86	2.56
M017	BOBCAT	3.81	4.16	2.97	4.16
M021	LEAST CHIPMUNK	2.20	2.20	2.20	2.20
M026	COYOTE	9.00	7.00	7.00	7.00
M029	NUTTALL'S COTTONTAIL	.80	2.70	2.70	2.70
M030	MULE DEER	9.00	3.62	3.03	6.23
M032	COMMON ELK	8.32	4.94	4.64	4.84
M033	ERMINE (SHORTTAIL WEASEL)	4.34	4.34	4.34	4.34
M038	RED FOX	4.66	3.76	3.76	2.50
M042	NORTHERN POCKET GOPHER	1.49	2.05	2.05	1.43
M045	SNOWSHOE HARE	3.70	3.19	5.98	5.98
M047	WHITE-TAILED JACK RABBIT	.60	0.00	0.00	0.00
M050	PINE MARTEN	0.00	2.96	5.28	.92
M058	DEER MOUSE	6.00	4.60	4.60	4.60
M072	WESTERN JUMPING MOUSE	7.50			0.00
M075	YELLOW-BELLIED MARMOT	1.70	1.70	1.70	1.70
M076	MUSKRAT	6.73	6.73	6.73	6.73
M089	GUNNISON'S PRAIRIE DOG	0.00	0.00	0.00	0.00
M091	ROCKY MOUNTAIN PIKA	0.00	.52	.72	.56
M094	PORCUPINE	0.00	5.20	0.00	.50
M096	RACCOON	0.00	0.00	0.00	0.00
M105	MASKED SHREW	5.94	7.30	7.47	4.50
M107	NORTHERN WATER SHREW				
M111	STRIPED SKUNK	0.00	0.00	0.00	2.00
M117	GOLDEN-MANTLED GROUND SQUIRREL	1.40	3.00	2.00	2.00
M119	RED SQUIRREL	0.00	6.00	7.50	3.96
M128	LONG-TAILED VOLE	1.50	1.50	1.50	1.50
M129	MEADOW VOLE	.70	0.00	0.00	0.00
M131	MOUNTAIN VOLE	6.00	0.00		
M144	LONG-TAILED WEASEL	3.60	3.60	3.60	3.60
R063	WESTERN TERRESTRIAL GARTERSNAKE	9.00			

Appendix J. Statement Distribution

APPENDIX J: STATEMENT DISTRIBUTION

Federal Organizations

Advisory Council - Historic Preservation
Lakewood, CO

Agricultural Stabilization & Conservation Service
Denver, CO

Army Corps of Engineers
Grand Junction, CO

Army Corps of Engineers
Sacramento, CA

Bureau of Land Management
Denver, CO

Bureau of Land Management
Montrose, CO

Bureau of Mines
Denver, CO

Bureau of Outdoor Recreation
Denver, CO

Bureau of Reclamation
Grand Junction, CO

Colorado District
U. S. Geological Survey
Denver, CO

Colorado State Conservation Service
Denver, CO

Curecanti National Recreation Area
Gunnison, CO

Department of Commerce
Denver, CO

Department of Energy
Denver, CO

Department of Energy
Lakewood, CO

Department of Health, Education & Welfare
Denver, CO

Department of Housing & Urban Development
Denver, CO

Department of Interior
Lakewood, CO

Department of Labor
Denver, CO

Environmental Protection Agency
Denver, CO

Federal Highway Administration
Denver, CO

Health and Human Service
Denver, CO

National Park Service
Denver, CO

Office of General Council
Denver, CO

Office of General Council
Denver, CO

Rio Grand National Forest
Monte Vista, CO

Rural Electrification Administration
Washington, D. C.

Soil Conservation Service
Alamosa, CO

Soil Conservation Service
Denver, CO

Soil Conservation Service
Gunnison, CO

U. S. Fish & Wildlife Service
Salt Lake City, UT

U. S. Geological Survey
Denver, CO

Water & Power Resource Service
Grand Junction, CO

White River National Forest
Glenwood, Springs, CO

Federal and State Elected Officials

Honorable William L. Armstrong
Honorable Tilman Bishop
Honorable Hank Brown
Honorable Mike Callihan
Honorable Frank Evans
Honorable Gary Hart
Honorable Martin Hatcher
Honorable Raymond P. Kogovsek
Honorable Ken Kramer
Honorable John Lillpop
Honorable Dan Noble
Honorable Patricia Schroeder
Honorable Tim Wirth

State Agencies

Air Pollution Control Division

Colorado Geological Survey

Colorado State Clearing House

Colorado State Forest Service

Department of Natural Resources

Division of Employment and Training

Division of Mines

Division of Transportation Planning

Divison of Water Resources

Division of Wildlife

Environmental Affairs

Governor of Colorado

Mined Land Reclamation Board

Office of Environmental Programs

Office of Medical Care Service

Radiation/Hazardous Waste Cont. Div.

State Board of Land Commission

State Compensation Insurance Fund

Water Quality Control Division

Local Governments

Chaffee County
Board of Commissioners

Board of Gunnison County
Commissioners

City Manager
Crested Butte, CO

City Planner
Crested Butte, CO

City Manager
Gunnison, CO

City Manager
Mt. Crested Butte, CO

City Planner
Mt. Crested Butte, CO

County Commissioner
Olathe, CO

Crested Butte Mayor

Delta County
Board of Commissioners

Delta County Courthouse

Gunnison City Planner

Gunnison County Courthouse
CJRP Coord., Dorothy Johnson

Gunnison County
Planning Commission

Gunnison County Planner

Gunnison Mayor

Hinsdale County
Board of Commissioners

Hotchkiss Mayor

Lake City Mayor

Mesa County
Board of Commissioners

Montrose City Manager

Montrose City Mayor

Montrose City Planner

Montrose County
Board of Commissioners

Mt. Crested Butte Mayor

Paonia City Manager

Paonia City Planner

Pacnia Mayor

Saguache Mayor

Salida Mayor

Salida City Manager

Salida City Planner

Saguache County
Board of Commissioners

Saguache Mayor

Organizations

American Motorcycle
Association
Westerville, OH

American Wilderness Alliance
Denver, CO

Aspen CTR For Environmental
Studies
Aspen, CO

Aspen Wilderness Workshop
Aspen, CO

Challenge - Discovery
(Wilderness CNTR)
Crested Butte, CO

Club 20
Grand Junction, CO

Colorado Mountain Club
Boulder, CO

Colorado Mountain Club
Denver, CO

Colorado Mountain Club
Grand Junction, CO

Colorado Open Space Council
Denver, CO

Continental Divide Trail
Society
Washington, D.C.

Crockett Wilderness Program
Crockett, TX

Environmental Coordinator
Aspen, CO

Environmental Defense Fund
Denver, CO

Federal Timber Purchasers
Association
Denver, CO

High Country Citizens' Alliance
Crested Butte, CO

Izaak Walton League of America
Aurora, CO

League of Women Voters

National Audubon Society
Boulder, CO

National Wildlife Federation
Boulder, CO

Sierra Club
Gunnison, CO

Sierra Club
Grand Junction, CO

Sierra Club
San Francisco, CA

The Nature Conservancy
Denver, CO

The Wilderness Institute
Denver, CO

CU Environmental Center
Boulder, CO

CU Wilderness Study Group
Boulder, CO

Western Colorado Audubon Society
Grand Junction, CO

Wilderness Society
Washington, D. C.

Wilderness Society
Denver, CO

Wildlife Management Institute
Portland, OR

News Media

Chaffee County Times
Buena Vista, CO

Colorado Magazine
Denver, CO

Crested Butte Chronicle
Crested Butte, CO

Crested Butte Pilot
Crested Butte, CO

Daily Sentinel
Grand Junction, CO

Delta County Independent
Delta, CO

Denver Post
Denver, CO

Forum Newspaper
Nucla, CO

Gunnison Country Times
Gunnison, CO

KDTA-AM Radio
Delta, CO

KGUC - AM
Gunnison, CO

KOTO - FM
Telluride, CO

KREX - Radio and TV
Grand Junction, CO

KREY - TV
Montrose, CO

KUBC AM-FM Radio
Montrose, CO

KVLE - FM
Gunnison, CO

KWDE - FM
Montrose, CO

Montrose Daily Press
Montrose, CO

North Fork Herald Chronicle
Hotchkiss, CO

North Fork Times
Paonia, CO

Ouray County Plaindealer
Ouray, CO

Palisade Tribune
Palisade, CO

Paonian
Paonia, CO

Rocky Mountain News
Denver, CO

Saguache Crescent
Saguache, CO

Salida Mountain Mail
Salida, CO

Silverton Standard
Silverton, CO

Silver World
Lake City, CO

Telluride Times
Telluride, CO

XYZ Television, Inc.
Grand Junction, CO

Individuals

Larry Abbott
Glen W. Adams
Seth Adams
Logan Allen
Paul R. Allen
Ralph R. Allen
Jim Anderson
Noel Andress

Jan Andrews
Richard D. Andrews
Dr. Keith A. Argow
Bob Arkin
Jack Armstrong
Michael Arts
Hon. Wayne Aspinall
Shipley Associates

Harvey Atchison
Jim Austin
H.A. Bachman
Tim Bacon
Susie Bailey
John C. Balla
Fred Barnabei
Betsy Barnett

Ralph M. Barnett
Billy Barr
Hamlet Barry III
Bruce Bartelli
James D. Batchelor
Bear Creek Mining Co
Margaret Berard
John S. Berge

Christina Best
Joseph Binder
Rob Bishop
Charles Bishopp
Henri Bisson
Dr. John R. Bizer
Dee Blacklock
Norman Blake

James F. Blakey
Roger M. Blouch
Joe Blumberg
Tom Boggess
Tom Borden
Fred Bosselman
Julie Bowden
Susan Boyle

Richard L. Bratton
R. K. Brenimer
Gary Brenner
Loyle K. Brennise
Judy Briscoe
Greg Brown
Larry F. Brown
Frank Buffington

Mary Bunt
Merritt Burdick
Robert Burford
Gary D. Burkholder
Raymon L. Burrell
Dr. John J. Cabouch
Dr. W.A. Calder
Russ Caldwell

Al Campbell
J. W. Campbell
Lou Campbell
Robert Campbell
Kriss Cannon
Cynthia Carey
Dave Carlson
William A. Carlson

Alan Carpenter
Neil F. Casson
Narcissa Channel
Irvin Chapman
James G. Cheney
Candice Chnslip
Nan Chobot
Bob Clark

Ralph E. Clark III
Robert Codfrey
Jim Coiner
Theo Colburn
David R. Cole
College of NFR, Dean
Colo. Counties Inc.
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Conservation Library
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Kimberly Cook
Michael Cooper
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John Cope

Marilyn Cope
Susan Cottingham
T.H. Coughlin
Michael Counts
T.S. Cox
Carl Cranor
Ralph Cranor
Karen Crassweller

Steve Crumrine
CSU Library
Kirk Cunningham
Allen Curtis
Anne Curtis
Bud Curtis
Mark Daily
Robert Dalbac

Bill Daniels
Luk Danielson
Richard E. Day
James Dean
Ernest Degutes
Jane Dejonghe
David Delcour Esq.
Stanley Dempsey

Eric Dern
Jerry Deverell
Delta Co Develop.
Tim Devereux
Stan Dobson
Fredrick Dorsett
A. Paul Douglas
Joe Doyle

Betsy Dreyer
Ralph Driear
Jack A. Durham
Steve J. Durham
Richard B. Eagenn
Debra East
Ben Eastman
Myron G. Eckberg

Neil Edstrom
Dave Edy
Dave Efken
Anne H. Ehrlich
Paul R. Ehrlich
Art Ellis
Scott Ellis
Connie Elze

R.K. Enders
Dale Engquist
Chris Ensenberger
Hon. C. K. Enstrom
M.A. Esmiol
E. Evan
R. Evan
Max T. Evans
Robert Evans
Dr. Hugo Ferchau

Robert L. Ferguson
Kerry Fischer
M. Flanagan
Elizabeth Flanagin
Will Folger
Keith C. Foster
Wallace D. Foster
George C. Francis
Russel Freeman
W.R. Freudenburg

Gary F. Frey
Aaron Friedman
Dr. H.P. Friesema
Mark Fuller
David Galinat
Mike Gansceki
Leo Garcia
John Gardiner
Dolores Garland
David L. Gaskili

Mike Gaughan
Susan Gemmell
Jim Geier
Richard Gerdes
Jeanette Gerry
Colleen A.M. Gibbs
Mike Gippert
Don Glaeski
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William A. Goldman
K.M.Goldsmith
Bob Golten
Karen Good
Carroll Goodwin
Kathleen Gordon
Chuck Grand Pre
Mary Ann Grasser

Steve Gray
Gary Greer
Jack Grieb
Ray Gronwall
Jim Grunow
Michael Guerrieri
R.D. Haack
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John H. Hahn

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Shannon Haley
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David J. Ham
Horace B. Ham
Terry Hamlin
John Hammer
Chris Hansen
Deann Hanson

Jerry T. Hanson
Dr. John Harte
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Tom Henry
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Doug Hjelmstad
Dr. John Holdran
Jim Houston

Dennis D. Hovel
Dr. Jeff Howry
Dale Howard
Edy Hughes
Dr. Jeanne Hull
G.B. Hutchinson
Carla Hyde
Dave Ingrant
Paul Intemann
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Raye L. Jacobs
Rayle L. Jacobson
Dolores Jacobson
Greg S. Jacobson
Herb Jacobson
Brad Janes

Dan Jobin
Dennis Johns
Carol Johnson
Douglas A. Johnson
E. R. Johnson
John J. Johnson
Luanne L. Johnson
David Johnston
Marilyn Jones
Paul C. Jones

Timothy L. Jones
Charles Jordan
Pat T. Julio
Dr. Robert Kamen
Paul Kaplan
Cindy Kaplan
David Kaufman
Col. P. F. Kavenaugh
Desmond P. Kearns
Larry Keenan

Brian Kelly
John F. Kelly
C. Kennedy
Carolyn Kingsmith
Kellie Kirkham
Jim Kirschenman
P. C. Klingsmith
Mary Beth Knisley
John W. Knowles
Jerry Kowal

Doug Kraft
D. J. Krasowski
John Kromer Jr.
Bob Krull
Peggy Kuhn
C. J. Kuiper
Noel Kurai
Jim Kuziak
Bill Lackman
Rial Lake

Carolyn Landes
Daniel J. Larkin
Christine Larson
George Lauderdale
Thomas Lawley
Doug Lee
David Lefevre
Ron Lehr
David Leinsdorf
David Levinson

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Michael K. Lewis
Patricia E. Lewis
Steve Lewis
Wes Light
Linda Lindsey
Jane Linville
Greg Lockett
Steve Longshore
Dennis Lothrop

Paul Lowdenslager
Judy Lowe
W. J. Lucas
Carla I. Ludwig
Sam Lumb
Dennis Lynch
Nick Lypps
D. Maddalone
Patrick R. Madill
Donald A. Maguire

John J. Malensek
Chuck Malick
Jerry G. Mallett
Alan P. Maloney
Dick Mangan
Gary Marich
Barbara Markwood
William E. Marlott
Tom Marshall
Donald G. Mashburn

Gary Massaro
Betsy Marston
Bill May
Catherine McCuthen
Kim R. McDonald
Walter H. McDonald
Raymond D. McKinney
Larry Mealhaff
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Ray M. Merrill
Clifton Merritt
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Charles Metzer
Doug Miller
Scott Miller
Henderson Mine
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Norm Muller
Emmett J. Murphy
Ceil Murray
Jim Murray
Clark Musgrove
Meg Nagel
Sue Navy
Alan Neifeld
Sara Neustadtl
E. D. Newell

Lance Nimmo
Richard Noll
Dave Nordwall
Art Norris
Arthur J. Norris
Beatrice Norris
Melina Norris
John Nunnery
M. T. O'Brien
Richard O'Brien

William J. O'Brien
Paul O'Conner
Sister O'Malia
George T. O'Malley
Alan O'Neill
Clair Oursler
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Mark Paich
Steve Parks
Monte C. Pascoe

R. J. Patterson
Jack Patton
Kristin Paulson
Carol Pearson
B. L. Pecharsky
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Fredrick F. Pierce
Amos A. Plante
Adam Poe

C. E. Porterfield
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Cal Queal
Bill Quinn
Kim Ragotzkie
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Missy Reda
Charlotte Redden
Martin A. Rehm
Diane Rhodes
Richard Richards
J. F. Rinckel
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RMES Library
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Lloyd Roberts
Tom G. Roberts
Ronald Robinson
Ruth Rodriguez
Rowena Rogers
John Rold
Ted S. Romanik
ROMCOE

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G. L. Rosentrater
Ted Rouillard
Zelda J. Rouillard
Robert J. Rozman
Jan Rubin
H. E. Rudi
Ray Ruehle
Nancy Ruehle
H. F. Russell

James H. Ryan
Clare Ryland
Anthony Sabatini
Diana M. Salazar
Trio Sales Inc.
Al Samples
Irvin C. Sanders
James W. Sanderson
Santo Sangosti
George H. Saum

Garbis Sariyan
Andell Sawdo
Sally Sawyer
Don Scar
Connie Schlepp
Liv Schmale
Steve Schmitz
Michael Schneider
Kimberly Schoppert
Hal Scott

Mike Scott
Bevie Seawell
Ross V. Seeton Jr.
Becky Selle
Mary Sewell
Timothy Shaffer
Kathy Shaw
David C. Shelton
Rex Sheppard
Scott D. Sherwood

Robert Shields
Ann B. Shrake
J. T. Shrigley
W. Michael Shuster
Hal Simpson
John Sisk
Gerald D. Sjaastad
Shelby Sjoberg
Mary Sjoberg
Tim Slusher

Audrey Smith
Brenda Smith
Doug Smith
Joseph Smith
Morgan Smith
Paula Smith
Roy Smith
Gary Snell
Gary Snider
Jim Somrak

Jim Soule
Virgil Spann
Lee Spann
B. Spehar
Ben Sprouse
Gary Sprung
H. J. Stalf
Cindy Stark
Jim Starr
John Starrs

Eric Steacy
W. K. Stegall II
Anne Steinbeck
Alan M. Stewart
Doug Stewart
Jan Stewart
J. B. Stone
Nancy Strong
Lewis Sturm
David Sumner

SUNEDCO
Mitchell Swain
Sally Swain
Dr. John Tarr
Susan Tarlton
Derrell P. Thompson
Geoff Tischben
J. W. Todd
William Tomlinson
Kathy A. Tonnessen

Arthur Townsend
Ann Tracey
Dora Mae Trampe
Dr. Frank Traylor
Henry Truebe
Bob Tweedell
Grant Tyson
Dallace Unger
John D. Vanderhoof
R. P. Van Tuyl

Pat Venturo
Ann Vickery
James Violett
Joyce Violett
Hon. W. J. Wadlow
Kenneth Waesche
W.S.E.R.C.
Louis S. Wall
Arden Wallum
Dave Walsh

Rocky Warren
Daniel Watt
Kenneth L. Watters
Erick W. Weidmann
Joanne Weiss
Ruth Welch
Noel Wellborn
Lynn Wetherell
Al Whitaker
David White

Willis H. White
Dr. Scottii Willey
C. Ray Wilson
Janet Wilson
Marian Wineman
Dick Wingerson
Pat Winn
A. W. Wise
Donald R. Witlow
Steve Wolcott

Rodney L. Woods
Betty Worey
R. E. Wright, Jr.
Donna Wyatt
Marlene Zanetell

GLOSSARY

GLOSSARY

Acre-foot - The amount of water which covers an acre of land to a depth of one foot; equal to 325,827 gallons.

Adjustment (of landownership) - The actual process of changing ownership to achieve the ownership approved in the land management plan or classification study.

Aesthetics - Pertaining to the quality of human perceptual experience (including sight, sound, smell, touch, taste, and movement) evoked by phenomena or elements or configurations of elements in the environment.

Airshed - An area of land over which the pattern of air movement is influenced by major topographic features.

Allotment - An area of land where one or more individuals graze their livestock. It generally consists of public lands but may include parcels of private or state owned lands. The number of livestock and season of use are stipulated for each allotment.

Alluvium - A general term for material deposited by streams; includes gravel, sand, silt, and clay.

Analysis - A separating or breaking up of any whole into its component parts for the purpose of examining their nature, function, relationship, etc.

Animal Unit Month (AUM) - The quantity of forage required by one mature cow (1,000 lbs.) or the equivalent for one month.

Arterial Roads - Roads which provide service to large land areas and usually connect with public highways or other Forest arterial roads to form an integrated network of primary travel routes. Formerly called Interim Development or Land Access Roads.

Aspect - The direction toward which a slope faces.

Background - The distant part of a landscape located from 3 to 5 miles to infinity from the viewer.

Baseflow - The contribution of groundwater to surface flow; an important factor in fall and winter streamflow.

Baseline studies - Studies of near natural environmental (i.e. physical, biological, social, and economic) conditions used as a basis for comparison with studies done on similar areas where various types of uses and practices have been or will be applied.

Basin - The drainage area of a river and its tributaries.

Bench - A flat area on otherwise sloping terrain.

Benefit - Desirable effects of a plan or action.

Big game - Large animals hunted, or potentially hunted, for sport; in Gunnison County: elk, mule deer, bighorn sheep, and black bear.

Big game summer range - The area which supports big game during the spring, summer and fall.

Block caving - A mining technique that involves undercutting of the ore.

Board Foot - A unit of measurement in timber represented by a board one foot long, one foot wide, and one inch thick.

Btu (British thermal unit) - The standard unit for measuring the amount of heat energy such as the heat content of fuel. Equal to the amount of heat energy necessary to raise the temperature of 1 pound of water 1 degree Fahrenheit. Generally speaking, one Btu is about equal to the amount of heat given off by burning a wooden kitchen match.

Calving area - Area used by cows for about two weeks when their calves are born. For elk, it is usually an opening with low brush cover near aspen and conifer tree cover.

Circuit - A combination of interconnected devices forming a closed path over which electric current is intended to flow.

Classification - (in relation to landownership objectives) The act of determining through analysis and documented study, the lands which are most suitable for National Forest System purposes and which are most suitable for other ownership.

Coarse textured - The texture exhibited by sands and loamy sands.

Cobbly - An adjective incorporated into the soil textured class description when the soil mass contains bewteen 15 and 90 percent by volume of cobble stones.

Code of Federal Rgulations (CFR) - The codification of regulations which implement Acts of Congress, Executive Orders or policies promulgated by Federal agencies. A reference to the Code is usually written "43 CFR 1508" which means that a reference is found in Title 43 of the Code, Section 1508. For example, regulations directing the Forest Service are found mainly in Title 36; BLM's regulations are mainly in Title 43.

Colluvial - Soil material that has moved downhill and has accumulated on lower slopes and at the bottom of a hill.

Colorado State Highway Class D Standards - A specific design designation that includes the following standards or criteria:

Traffic levels - 61-650 ADT
- 11-100 30th highest hour traffic volumes
Pavement types - less than or equal to 3 inches of bituminaus pavement

Land Width - 10 to 11 feet

Shoulder Width - 4 feet

Design Speed - 30-70 mph

Conifer - A broad classification of trees, mostly evergreens that bear cones and have needle-shaped or scalelike leaves; timber commerically identified as softwood.

Coniferous forest (see also "conifer") - A forest dominated by cone-bearing trees.

Constraint - The state, quality, or sense of being restricted to a given course of action or inaction; something that restricts, limits or regulates.

Corridor - A linear strip of land which has ecological, technical, economic, social, or similar advantages over other areas for the present or future location of transportation or utility rights-of-way within its boundaries.

Cover - Vegetation used by wildlife for potection from predators, or to ameliorate conditions of weather, or in which to reproduce; also a shortened version of "crown cover."

Cretaceous - The final period of the Mesozoic Era (after the Jurassic and before the Tertiary period of the Cenozoic Era) thought to have covered the span of time between 136 and 65 million years ago; also the corresponding system of rocks.

Criteria - Measurements which are used to examine or establish the relative degrees of desirability among alternatives or the degree to which a course of action meets an intended objective.

Critical big game winter range - That are essential for big game during severe winters. Critical big game winter range has been identified for bighorn sheep, mule deer, and elk.

Cultural resource - Evidence of past human behavior.

Cultural resource classification -

Class I. Those properties that have been evaluated and meet the eligibility criteria for inclusion in the National Register of Historic Places or other Federal, State, or local registers.

Class II. Those properties that have not been sufficiently evaluated for inclusion in the National Register of Historic Places or other Federal, State or local registers.

Class III. Those properties that have been evaluated and do not meet the eligibility criteria for inclusion in the National Register of Historic Places or other Federal, State, or local registers.

Degree days - The average of the daily maximum and minimum temperatures of any given day. The degree day value for any given day is the difference between 65 degrees and the average daily temperature. Example: Mean daily temperature of 50 degrees--the degree days are 65 minus 50 or 15 degree days. They measure the severity of the entire season.

Demand load - The requirement of electrical energy measured in 15-minute cycles for commercial operations. The price of electric usage is directly related to the level of this demand. The higher the demand, the higher the cost per electrical unit.

Developed recreation - That type of recreation which tends to be centered around man-made developments, such as campgrounds, resorts, ski areas, etc. (Types III, IV and V Recreation)

Developed site - A tract of land modified with facilities such as parking lots, tables, sanitary systems, etc., to accommodate intensive type recreation activities by providing comforts and conveniences as well as safety and sanitation for the users.

Dispersed recreation - That type of recreation which tends to be spread out over the land such as hunting, fishing, snowmobiling, hiking, driving for pleasure, cross-country skiing, motorbiking, mountain climbing.

Diversity - The relative degree of abundance of differing wildlife species, plant species, communities, habitats, or habitat features per unit of area.

Domestic grazing - Consumption of available browse and non-woody plants by sheep, horses, cattle and other domestic livestock.

Drainage - A watershed; also a stream network.

Drawpoint - A place in a mine where caved or, broken ore is removed.

Drift - In the context of mining, refers to an underground tunnel that is horizontal or nearly so; in the context of glacial geology, refers to rock debris that has been transported and subsequently deposited by a glacier.

Double circuit - An electrical, transmission systems consisting of two circuits.

Ecotone - A transition between two or more biotic communities.

Edge - The place where plant communities meet or where succesional stages or vegetative conditions within plant communities come together.

Edge effect - the influence of one adjoining plant community upon the margin of another affecting the composition and density of the populations.

Elk calving habitat (see also "calving area") - A habitat used by elk for calving; usually located on spring-fall range in areas of gentle slope; contains forage areas and hiding and thermal cover close to water.

Endangered species - Any species which is in danger of extinction throughout all of a significant portion of its range other than members of the class Insecta which have been determined by the Secretary to constitute a pest whose protection under the provisions of this Act would present an overwhelming and overriding risk to Man.

Endemic - Native or confined to a certain region; having a comparatively restricted distribution.

Energy - That which does or is capable of doing work. It is measured in terms of the work it is capable of doing; for example, electric energy is commonly measured in kilowatt hours.

Environment - The sum total of all the external conditions that may influence organisms.

Environmental Impact Statement (EIS) - A document which discloses and compares the environmental consequences on a proposed action which has been determined to be a major federal action and reasonable alternatives to that action. The EIS is prepared under regulation implementing the National Environmental Policy Act, Title 43, Code of Federal Regulation, Section 1500 (43 CFR 1500). It is not a decision document in and of itself.

Ephemeral - Short-lived.

Erosion - The wearing away of the land surface by running water, wind, ice, or other geological agents.

Evaluation - An examination and judging conerning the worth, quality, significance, amount, degree or condition of something.

Fee title - Also called fee simple. Entire ownership in land subject to eminent domain.

Fell-field - A culture or community of dwarfed, scattered plants or grasses above timberline.

Fire hazard - A fuel complex defined by kind, arrangement, volume, condition, and location that forms a special threat of ignition or of suppression difficulty.

Fire risk - The chance of fire starting as determined by the presence and activity of causative agents such as man or lightning.

First order - An unbranched tributary of a stream.

Fishable stream - A stream usually over three feet wide which supports a population of fish.

Fishery - Aquatic habitat suitable for the production of fish.

Forage - All browse and herbaceous food available to livestock and wild animals.

Foreground - Generally the area that lies within one-fourth mile of the viewer; details such as stumps and rocks being readily visible.

Forest land - Land at least 10 percent occupied by trees of any size, or formerly having had such tree cover, and not currently developed for non-forest use.

Forest types - A classification of forest land by the tree species forming most of the stocking. Where no species comprises a majority of the stand, types are based on plurality of stocking.

Geomorphic - The shape of the earth's surface resulting from geologic processes.

Glaciated lands - Landforms shaped by glacial action.

Grazing allotment - An area designated for the use of a prescribed number of domestic livestock under one plan of management.

Habitat - The natural environment of a plant or animal, including all biotic, climatic, and soil conditions, or other environmental influences affecting life.

Historic and Cultural Sites - These sites are associated with the human history, tradition or cultural heritage of national, state or local interest and are of enough significance to merit preservation or restoration.

Holistic - Emphasizing the importance of the whole and the interdependence of its parts.

Horsepower - British unit of power; 1 H.P. equals the capacity to produce 746 watts or 42.408 Btu's per minute.

Hydroelectric plant - An electric power plant in which the turbine-generators are driven by falling water.

Igneous - Rocks evolving from molten material and of two types: (1) those cooled from molten masses beneath the earth's surface (intrusive rocks), and (2) those cooled from molten masses flowing or forcibly extruded upon the earth's surface (extrusive rocks).

Input-Output analysis - A systematic technicque for quantitatively analyzing the interdependence of producing and consuming units in an economy. It studies the interrelations among producers as buyers of each other's outputs, as users of scarce resources and as sellers to final consumers. The technique has been useful for the study of the way in which the component parts of an economy fit together and influence each other, for short-run forecasting, and for policy guidance.

Interdisciplinary Team - A group of individuals with different training assembled to solve a problem or perform a task. The team is assembled out of recognition that no one scientific discipline is sufficiently broad to adequately solve or analyze environmental problems. The members of the team proceed to the solution with frequent interaction so that each discipline may provide insights at any stage of the analysis and combine to provide new solutions.

Intermittent - Stopping and starting at intervals.

Invertebrate - An animal lacking a spinal column.

Issue - A point of debate or controversy.

Junior water rights - In the language of Colorado water law, these are rights with a recent appropriation date. It is common for these rights to go unfilled because of inadequate water.

kW (kilowatt) - 1,000 watts.

kWh (kilowatt hour) - A unit of work energy equal to that expended by 1 kilowatt in 1 hour; equal to 3,413 Btu's.

Lek - A site where birds (primarily grouse) traditionally gather for sexual display and courtship.

Levels of service - In relation to roads, levels of service, designated A through E, reflect the amount and flow of traffic considered optimal, comfortable, and excessive, with varying degrees between.

Life cycle cost - The total costing of new equipment for a life-time period (usually 25 years), including anticipated dollar outputs for maintenance and operation.

MBF - Lumber or timber measurement term. One thousand board feet.

Megawatt - A megawatt is a million watts or a thousand kilowatts and is used to measure the amount of electricity that can be produced by a power plant at any one time; often abbreviated as Mwe or MW.

Middleground - The area between the foreground and background in a landscape. The area located from 1/4 to 1/2 mile to 3-5 miles from the viewer.

Migration corridor - A belt, band, or stringer of vegetation that provides a completely or partially suitable habitat and which animals follow during migrations.

Migration route - A travel route used routinely by wildlife in their seasonal movement from one habitat to another.

Mitigation - To lessen in force or intensity. To moderate the severity.

Moraines - An accumulation of glacial drift with a distinct topographic expression.

Multiple Use - The management concepts under which National Forest lands are managed. It involves the management of renewable resources in combinations that will best serve the public. Generally in any specific location a single resource will tend to have dominance over the others and will be more influential in determining management goals and direction. On a large land base, the collective utilization of the varied resources constitutes multiple use of the forest.

National Forest - In the United States, a Federal reservation of forest, range. or other wild land administered by the Forest Service of the U.S. Department of Agriculture under a program of multiple use and sustained yield.

National Register of Historic Places - A list (maintained by the National Park Service) of areas which have been designated as being of historical significance. The Register includes places of local and state significance as well as those of value to the nation.

Natural gas - A mixture of lightweight hydrocarbons in geological deposits, with the predominant compound being methane.

NFS - National Forest System

NEPA - National Environmental Policy Act

Non-Point pollution source - A source of pollution from a general area as opposed to being generated from a specific point.

Nuclear electric power plant - One in which heat for raising steam is provided by fission rather than by combustion of fossil fuels.

100-year flood - A flood that occurs once every 100 years; larger ones occur less often, smaller ones more often.

Organism - Any living individual of any plant or animal species.

PAOT - Persons-at-one-time; a unit of measure for recreation capacity.

Panel caving - A mining technique that involves undercutting a horizontal zone, or panel, of ore. The uppermost panel is extracted first.

Parent material - Geologic material from which soils are developed.

Patent - A document conveying title to land from the U.S. Government to private ownership.

Perennial stream - A stream that ordinarily has running water on a year-round basis.

pH - A notation designating acidity; a pH of 7 indicates neutrality; higher values indicate less acidity and lower values indicate more acidity.

Pollution - Human-caused or natural degradation of water, air, or other aspects of the environment.

Probable Maximum Flood - A flood calculated to be the largest possible under any circumstances.

Range - In statistics, an elementary measure of the dispersion of a set of random variables, equal to the largest minus the smallest; in land classification, all land, including forest land, that produces native forage in contrast to land cultivated for agricultural crops or carrying dense forest; in wildlife management, the general area occupied by a particular animal, often on a seasonal basis, such as elk winter range.

Rate of return - The long term return on an investment, expressed as an average annual percentage.

Reagent - A substance used to convert one substance into another by means of the reaction which it causes.

Record of Decision - A document which discloses the decision on a major federal action and the reasons why the decision was made; it is signed by the official responsible for implementing the identified action. The environmental consequences disclosed in an Environmental Impact Statement are considered by the responsible official in reaching a decision.

Recreation, Developed - See Developed Recreation

Recreation, Dispersed - See Dispersed Recreation

Recreation visitor day (RVD) - Twelve visitor-hours, which may be aggregated continuously, intermittently or simultaneously by one or more persons.

Riparian - Situated on the banks of a streamcourse or, sometimes, a standing body of water.

Riparian zone - An area identified by the presence of vegetation that requires free or unbound water or conditions more moist than normally found in the area.

Room-and-pillar - A mining technique that involves a grid of rooms separated by pillars of uniform cross-section.

Ruminant animals - Any of a group of four-footed, hoofed, even-toed, and cud-chewing mammals as the cattle, buffalo, goat, deer, antelope, sheep, etc.

Runoff - Precipitation that is not retained on the site where it fell; natural drainage away from an area.

Sawtimber - Live trees 9 inches or larger at diameter breast height and containing at least an eight-foot log.

Scarp - A cliff or other near-vertical slope.

Second-order stream - See stream order.

Sediment - Material suspended in liquid or air; also, the same material once it has been deposited.

Sedimentary rocks - Rocks formed by the accumulation of sediment.

Senior water rights - In the language of Colorado water law, these are rights with an early appropriation date. There is normally adequate water available to fill these rights.

Scrubber - Equipment used to remove pollutants (such as sulfur dioxides or particulate matter) from stack gas emissions.

Sensitivity level - A particular degree or measure of viewer interest in and concern for the scenic quality of the landscape. Three sensitivity levels are employed:

Level 1 - Highest sensitivity. Includes all seen areas from primary travel routes, use areas and water bodies where at least one-fourth of the Forest viewers have a major concern for scenic qualities.

Level 2 - Average sensitivity. Includes all seen areas from primary travel routes, use areas, and water bodies where fewer than one-fourth of the Forest visitors have a major concern for scenic qualities. Level 2 also includes all seen areas from secondary travel routes, use areas, and water bodies where at least one-fourth and not more than three-fourths of the Forest visitors have a major concern for scenic qualities.

Level 3 - Lowest Sensitivity. Includes all seen areas from secondary travel routes, use areas, and water bodies where less than one-fourth of the Forest visitors have a major concern for scenic qualities.

Slope - The incline of the land surface measured in degrees from the horizontal or in percent as determined by the number of units change in elevation per 100 of the same measurement units; also, characterized by the compass direction in which it faces.

Sock line - A rope or cable used to pull heavier pulling line or conductor through pulleys hung in a tower.

Soil - The unconsolidated mineral materials on the immediate surface of the earth that serves as a natural medium for the growth of land plants, is a storage system for water and is a material for constructing roads and dams.

Special Interest Area - An area of National Forest System land recognized as having unusual scenic, historic, prehistoric, scientific, natural or other special interest which merit special attention and management. The areas are set apart and reserved for public use under the authority of 36 CFR 294.1.

Species - A unit of classification of plants and animals consisting of the largest and most inclusive array of sexually reproducing and cross-fertilizing individuals which share a common gene pool; the most inclusive Mendelian population.

Species richness - A measurement or expression of the number of species of plants or animals present in an area; the more species present, the higher the degree of species richness.

Spring-fall range - An area between summer range at high elevation and winter range at low elevation that is used by deer and elk during spring and fall as they move between summer and winter range.

Stand - A group of trees that has sufficient uniformity in species, age, and density to distinguish it from other stands around it.

Streamflow - The discharge (flow of water) in a natural channel.

Stream Order - This is a guage of stream size. A first order stream has no tributaries and is ordinarily small. A second order stream is formed by the joining of two first order streams.

Stringer - Vegetation arranged in a long, thin, linear fashion.

Succession - The changes in vegetation and in animal life that take place as the plant community evolves from bare ground to climax.

Summer range - A range, usually at higher elevation, used by deer and elk during the summer; a summer range is usually much more extensive than a winter range.

Tailing(s) - Waste material separated from ore during the milling process; commonly has sand-like qualities.

Talus - The accumulation of rocks at the base of cliffs or other steep slopes.

Threatened species - A wildlife species officially designated by the Fish and Wildlife Service as having its existence threatened in a localized area, such as State or province or lesser area, because its habitat is threatened with destruction, drastic modification, or severe curtailment, or because of overexploitation, disease, predation, or other factors.

Type - A site classified qualitatively by its climate, soil or vegetation; in forestry, usually based on the dominant tree species.

Unpatented claims - Mining claims located under the authority and by procedures defined in the 1872 mining laws as ammended and for which ownership of surface rights, fee title, has not been transfered to the claim owner.

Unregulated timber - Forest land that is suitable and available but not allocated for timber production under sustained yield principles; where timber harvest is permissible but not a goal of management.

Values - An individual or collective conception of that which is desirable. This conception usually has both emotional and symbolic components. Values may range from those that are subjectively meaningful to a given individual to those that are shared cultural norms. They influence the selection of the means and ends of actions, and they serve as criteria by which objects or actions are evaluated.

Variety classes (Visual Management System) - A particular level of visual variety or diversity of landscape character. Three classes are identified:

Class A - Distinctive. Areas where features of landform, vegetative patterns, water forms, and rock formations are of unusual or outstanding visual quality.

Class B - Common. Areas where features contain variety in form, line, color and texture or combination thereof but which tend to be common throughout the character type and are not outstanding in visual quality.

Class C - Minimal. Areas whose features have little change in form, line, color or texture.

Visitor day - A unit of measure of recreation use; equals twelve visitor-hours, which may be aggregated continuously, intermittently or simultaneously by one or more persons.

VQO - Visual Quality Objective (see also Visual Management Objectives).

Visual Management Objectives - Preservation. This visual quality objective allows ecological changes only. Management activities, except for very low visual impact recreation facilities, are prohibited. It applies to wilderness, primitive areas, other special classified areas, areas awaiting classification and some unique management units which do not justify special classifications.

Retention. This visual quality objective provides for management activities which are not visually evident. Activities may only repeat form, line, color and texture which are frequently found in the characteristic landscape. Changes in their qualities of size, amount, intensity, direction, pattern, etc., should not be evident.

Partial Retention. This visual quality objective provides for management activities that repeat form, line, color and texture common to the characteristic landscape; but changes in their qualities of size, amount, intensity, direction, pattern, etc., remain subordinate to the characteristic landscape. Activities may also introduce form, line, color or texture which are seldom or not found in the characteristic landscape, but they will remain subordinate to the dominant elements existing in the landscape.

Modification. This visual quality objective provides for management activities that may visually dominate the original characteristic landscape. However, activity alteration must borrow from naturally established form, line, color or texture at such a scale that its visual characteristics are those of natural occurences within the surrounding area or character type.

Maximum Modification. Management activities of vegetative and landform alterations under this alternative may dominate the characteristic landscape. However, when viewed as background the activity must appear as natural occurrences within the surrounding area of character type. When viewed as foreground or middleground, they may not appear to completely borrow from naturally established form, line, color or texture; or they may be out of scale with natural occurrences.

Water quality - The physical, chemical or biological condition of water relative to its intended use.

Watershed - A land area which collects and discharges its surface water through one outlet.

Wilderness - Land designated by Congress as a component of the National Wilderness Preservation System.

Wildfire - An unplanned fire requiring supression action, as contrasted with a prescribed fire burning within prepared lines enclosing a designated area under prescribed conditions; a free-burning fire unaffected by fire suppression measures.

Winter range - A range, usually at lower elevation, used by migratory deer and elk during the winter months; usually better defined and smaller than summer ranges.

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INDEX

INDEX

Access 124, 137, 159, 167, 172, 181, 184, 196, 199, 324

Acid Mine Drainage 30, 59, 109, 277, 311

Acid Rain 112

Agriculture 33, 128, 236

Air 30, 63, 110, 133, 139, 144, 148, 154, 165, 170, 176, 181, 184, 188, 194, 199, 203, 227, 231, 251, 253, 274, 312

Air Quality - Related Values 110

Alkali Creek Mill Site 12, 18, 20, 47, 50, 53, 60, 92, 149, 238, 330

Aquatic Ecology 29, 53, 106, 131, 138, 143, 152, 163, 174, 180, 187, 194, 198, 201, 226, 231, 309

Avalanche Hazards 33, 97, 129, 137, 140, 147, 148, 168, 179, 185, 191, 197, 219, 228, 232, 270, 325

Big Game See Elk and Deer

BMML 75

'Boom-Town' Impacts See Growth Impacts

Carbon Creek Mill Site 22, 24, 47, 51, 54, 62, 93, 173, 239, 330

Chance Gulch Mill Site 26, 47, 51, 62, 93, 182, 239, 331

Coal 94, 202

Coal Creek Mine Site 12, 18, 22, 24, 26, 46, 50, 53, 58, 90, 129, 237, 327

Coal Creek Municipal Watershed 30, 60, 131, 251

Crested Butte Historic District 31, 65, 113

Cultural Resources 31, 65, 112, 136, 139, 146, 158, 166, 171, 177, 181, 184, 189, 195, 199, 209, 227, 253, 255, 284, 315

Cumulative Impacts 256

Currecanti NRA 68

East River Plan 95, 325

Elk and Deer 29, 50, 52, 105, 130, 143, 149, 162, 170, 174, 180, 186, 192, 198

Energy 30, 54, 106, 131, 138, 143, 152, 163, 170, 175, 180, 183, 187, 194, 198, 201, 226, 231, 255, 310

Fire 74, 121, 136, 140, 146, 159, 167, 172, 178, 182, 184, 190, 196, 199, 209, 228, 318

Geology 32, 90, 126, 137, 147, 159, 168, 172, 219, 228, 232, 255, 270, 322

Grazing 127, 137, 147, 160, 169, 173, 178, 182, 191, 197

Groundwater 30, 58, 60, 62, 109, 132, 154, 163, 176, 188

Growth Impacts 124-126, 209-219

Housing 81, 214, 321

Iron Bog See Mt. Emmons Iron Bog

Irreversible and Irretrievable 254

Issues 6, 375

Land Classification 14, 19, 239, 353

Land Exchange 14, 19, 21, 23, 25, 27, 237, 365

Land Uses 33, 95, 127, 137, 140, 147, 148, 160, 168, 172, 178, 182, 185, 191, 197, 199, 219, 228, 254, 255, 324

Land Use Plans 95

Local Economy 78, 84, 126, 216

Methodology 379

Microfiche Reference System 6

Mill Sites 328, see also Alkali Creek Mill Site, Carbon Creek Mill Site, and Chance Gulch Mill Site

Mine Closure 218, 270

Mine Site 327, see also Coal Creek Mine Site and Slate River Mine Site

Mining Law 377

Mitigation Measures 11, 13, 19, 21, 23, 25, 27, 261, 301

Molybdenosis 103

Mt. Emmons Iron Bog 28, 49, 102, 129, 279, 302

Need for Molybdenum 376

'No Action' Alternative 11, 28-36, 122, 200-219

Noise 31, 65, 112, 133, 139, 145, 148, 158, 165, 170, 177, 181, 184, 189, 195, 199, 208, 227, 231, 253, 289, 314

Ore Haulage 12, 18, 20, 22, 24, 26, 161, 173, 185, 330

Outdoor Recreation 32, 68, 116, 136, 140, 146, 148, 159, 167, 172, 178, 181, 184, 190, 196, 199, 209, 228, 232, 251, 254, 317

Power Supply 13, 19, 21, 23, 25, 27, 219, 345

Prime Agricultural Lands 236

Project History 3

Public Services 84, 87, 89, 126, 215, 319

Quality of Life 214

Range See Grazing

Reclamation 101, 104, 108, 115, 127, 129, 131, 133, 136, 137, 138, 144, 146, 147, 159, 160, 165, 166, 171, 177, 178, 190, 194, 227, 229, 231, 292, 302

Roaring Judy Fish Hatchery 152, 154

Sage Grouse 29, 52, 130, 143, 152, 163, 170, 174, 180, 187, 193, 198

Sand and Gravel 94, 248, 292

Schedule 1, 374

Schools 90, 215, 321

Section 404 Dredge and Fill Permits 138, 143, 153, 164, 170, 175, 183, 194, 199

Services See Public Services

Short-term vs. Long-term 256

Slate River Mine Site 20, 47, 50, 53, 58, 90, 142, 238, 328

Small Mine 24, 28-36, 106, 111, 116, 124, 126, 200-219

Social Structure 76, 125, 213, 319

Socioeconomics 32, 75, 124, 136, 140, 146, 148, 159, 168, 178, 184, 196, 199, 209, 254, 255, 319

Soils 33, 94, 127, 137, 147, 160, 178, 190, 219, 228, 232, 254, 255, 270, 323

Special Uses 128, 137, 160, 169, 173, 179, 183

Subsidence 31, 209, 115

Sundew Plant 49, 102

Tailing Disposal Area 328, see also Alkali Creek Mill Site, Carbon Creek Mill Site, and Chance Gulch Mill Site

Threatened and Endangered Species 29, 50, 52, 103, 106, 129, 130, 138, 142, 143, 147, 149, 152, 161, 163, 170, 173, 174, 179, 180, 186, 187, 191, 193, 197, 200, 226

Timber 33, 127, 137, 147, 160, 169, 172, 178, 182, 185, 191, 197

Transportation 32, 74, 121, 140, 167, 172, 178, 182, 184, 196, 199, 209, 254, 318

Urban Recreation 89, 216, 319

Uses of Molybdenum 6

Vegetation 28, 45, 101, 129, 138, 142, 147, 149, 161, 169, 173, 179, 182, 185, 191, 197, 200, 223, 229, 253, 255, 279, 302

Visual Resources 31, 66, 114, 136, 139, 146, 148, 158, 166, 171, 177, 181, 184, 190, 196, 199, 209, 227, 231, 251, 253, 255, 316

Water 30, 56, 108, 131, 138, 143, 148, 153, 163, 170, 175, 181, 183, 187, 194, 199, 203, 226, 231, 249, 251, 253, 255, 274, 310

Water Rights 110, 153, 249

Water Supply 87, 216, 321

Wetlands 28, 47, 104, 130, 138, 142, 147, 149, 161, 170, 174, 179, 186, 191, 197, 200

Wilderness 68, 110

Wildlife 29, 50, 104, 130, 138, 142, 148,, 149, 161, 170, 174, 179, 182, 186, 192, 197, 201, 226, 229, 253, 255, 279, 305

Worker Access 12, 18, 20, 22, 24, 26, 138, 147, 169, 179, 191, 331

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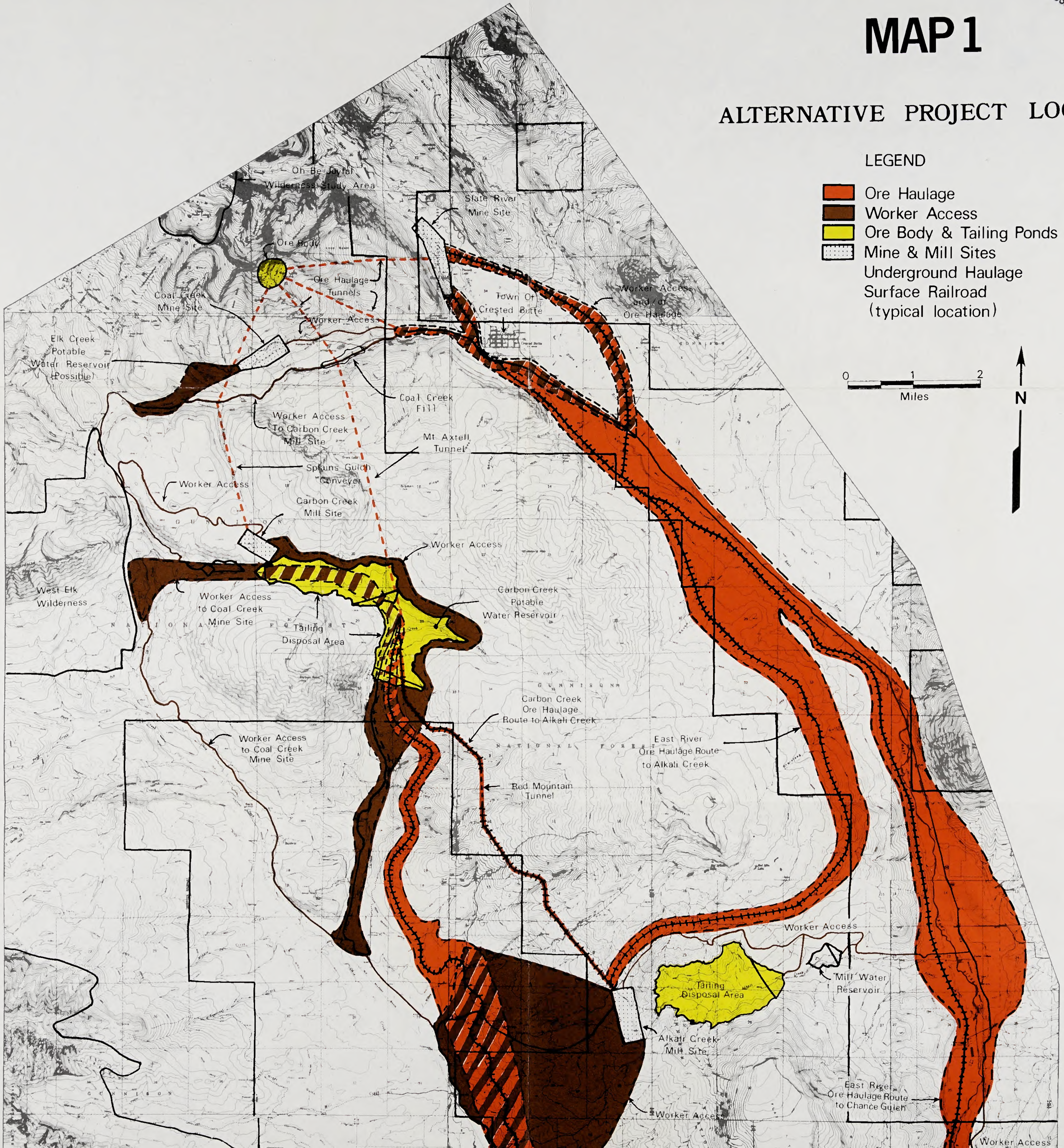
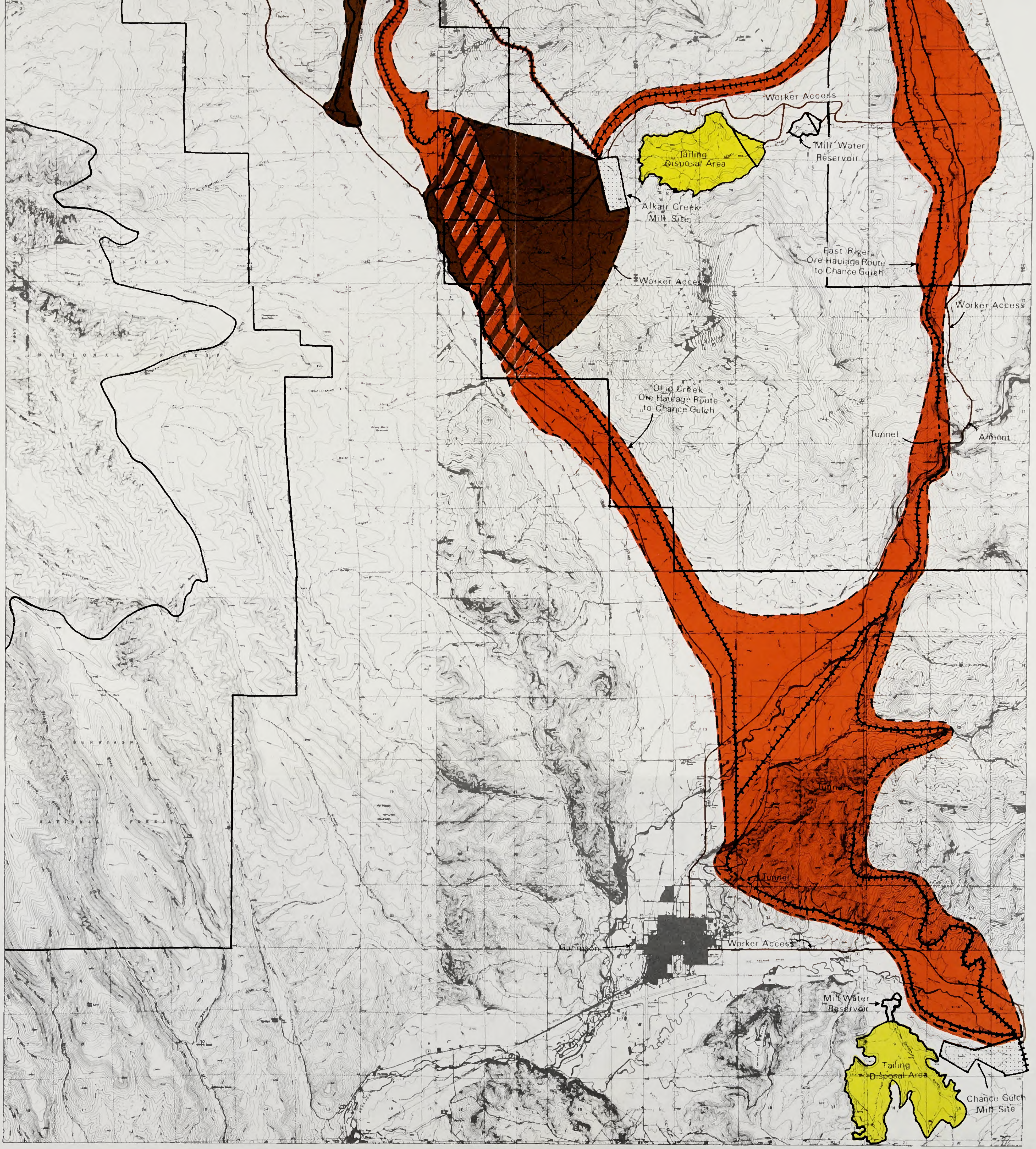
MAP 1

ALTERNATIVE PROJECT LOCATION


LEGEND
🟥 Ore Haulage
🟫 Worker Access
🟨 Ore Body & Tailing Ponds
▨ Mine & Mill Sites
Underground Haulage
Surface Railroad (typical location)
0
1
2
Miles
N
Oh-Be-Joyful Wilderness Study Area
State River Mine Site
Ore Body
Ore Haulage Tunnels
Coal Creek Mine Site
Worker Access
Town Of Crested Butte
Worker Access and/or Ore Haulage
Elk Creek Potable Water Reservoir (Possible)
Coal Creek Fill
Worker Access To Carbon Creek Mill Site
Mt Axtell Tunnel
Splains Gulch Conveyor
Worker Access
Carbon Creek Mill Site
Worker Access
West Elk Wilderness
Worker Access to Coal Creek Mine Site
Tailing Disposal Area
Carbon Creek Potable Water Reservoir
GUNNISON NATIONAL FOREST
Carbon Creek Ore Haulage Route to Alkali Creek
East River Ore Haulage Route to Alkali Creek
Worker Access to Coal Creek Mine Site
Red Mountain Tunnel
Worker Access
Tailing Disposal Area
Mill Water Reservoir
Alkali Creek Mill Site
East River Ore Haulage Route to Chance Gulch
Worker Access
Worker Access


Worker Access
Tailing Disposal Area
Mill Water Reservoir
Alkali Creek Mill Site
East River Ore Haulage Route to Chance Gulch
Worker Access
Worker Access
Ohio Creek Ore Haulage Route to Chance Gulch
Tunnel
Almont
Tunnel
Tunnel
Gunnison
Worker Access
Mill Water Reservoir
Tailing Disposal Area
Chance Gulch Mill Site

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Feet (ft)	3.048×10^{1}	Centimeters (cm).
	3.048×10^{-1}	Meters (m).
Miles (mi)	1.609	Kilometers (km).
Square feet (ft^{2})	9.290×10^{-2}	Square meter (m^{2}).
Acres	4.047×10^{-1}	Hectares (ha).
	4.047×10^{-3}	Square kilometers (km^{2}).
Acre-feet (acre-ft)	1.233×10^{3}	Cubic meters (m^{3}).
	1.233×10^{-3}	Cubic hectometers (hm^{3}).
Cubic yards (yd^{3})	7.646×10^{-1}	Cubic meters (m^{3}).
Pounds (lb)	4.536×10^{-1}	Kilograms (kg).
Short tons (tons)	9.072×10^{-1}	Metric tons (t).
Pounds per acre (lb/acre)	1.12	Kilograms per hectare (kg/ha).
Btu/lb	2.326	Kilojoules per kilogram (kJ/kg).
Gallons (gal)	3.785×10^{-3}	Cubic meters (m^{3}).
Gallons per minute (gal/min)	6.309×10^{-2}	Liters per second (L/s).
Degrees Fahrenheit (°F)	(1)	Degrees Celsius (°C).

[1] Temperature in °C=(temperature in °F-32) 1.8.